Journal of
CHRONIC
DISEASES

VOLUME 9 . NUMBER 6

JUNE, 1959

OL.
9
959

Respiratory

THE TOTAL LUNG CAPACITY AND ITS SUBDIVISIONS IN RESPIRATORY POLIOMYELITIS

CARLOS VALLBONA, M.D.,* AND
WILLIAM A. SPENCER, M.D.**
HOUSTON, TEXAS

From the Southwestern Poliomyelitis Respiratory and Rehabilitation Center

(Received for publication Nov. 22, 1958)

STUDIES of subdivision of lung capacity have been particularly helpful in the clinical management of respiratory poliomyelitis; measurements of vital capacity and its subdivisions are often used as indications of the degree of recovery of natural breathing ability and as objective guides for the scheduling of artificial respiration. Experience has shown, however, that measurements of comparable magnitude obtained from different persons often have quite varied and individual significance.

The importance of estimation of all the lung compartments has been established as larger experience has been gained with the clinical use of such measurements. The extreme variability encountered among individual patients and in the same person during the course of the disease deserves particular study. The literature provides sparse data[1,2] upon the total lung capacity and its subdivisions in poliomyelitis patients as paralysis precludes adequate voluntary muscular activity required for determinations of maximum lung volume. Techniques for measuring the functional residual capacity are not readily adapted to individuals undergoing artificial respiration.

Aided by grants-in-aid from The National Foundation.

*Assistant Professor, Departments of Pediatrics, Physiology, and Rehabilitation, Baylor University College of Medicine.

**Professor and Chairman, Department of Rehabilitation, Baylor University College of Medicine, and Medical Director of the Southwestern Poliomyelitis Respiratory and Rehabilitation Center.

TABLE I. PHYSICAL CHARACTERISTICS AND LUNG COMPARTMENT VALUES OF HEALTHY AND POLIOMYELITIS SUBJECTS

SUBJECT GROUP	STATISTICAL OBSERTION	TIME FROM ONSET (MO.)	AGE (YR.)	WEIGHT (LB.)	HEIGHT (IN.)	B.S.A. (SQ. M.)	PRE-ILLNESS B.S.A. (SQ. M.)	F.R.C. (L.)	ESTIMATED I.C. (L.)	T.L.C. (L.)	NATURAL I.C. (L.)	E.R.V. (L.)	V.C. (L.)
Healthy males (N = 25)	Range		19–38	130–200	63–73.5	1.71–2.16		1.84–3.75		4.82–8.37	2.65–4.89	0.27–2.00	3.19–5.77
	Median		26	162	69.5	1.90		3.11		7.02	3.89	0.97	4.86
Total male patients (N = 31)	Range	1–135	19–42	87–175	63.5–75	1.40–2.01	1.64–2.30	1.73–4.56	0.85–4.22	3.36–7.69	0.13–3.72	0.00–0.69	0.13–3.72
	Median	18	27	138	70.5	1.77	1.91	2.74	2.09	4.93	1.10	0.10	1.27
Males studied before 2 yr. from onset (N = 16)	Range	1–18	19–42	107–175	68–74	1.59–1.97	1.80–2.17	1.76–4.31	1.52–2.30	3.65–7.69	0.13–3.01	0.00–0.69	0.13–3.70
	Median	6	25	136	70.5	1.78	1.92	2.87	2.32	5.15	1.10	0.27	1.26
Males studied after 2 yr. from onset (N = 15)	Range	29–135	20–34	87–170	63.5–75	1.40–2.01	1.64–2.30	1.73–4.56	0.85–4.22	3.36–7.15	0.30–3.72	0.00–0.45	0.30–3.72
	Median	70	28	138	71	1.77	1.90	2.70	1.80	4.63	1.09	0.05	1.29
Healthy females (N = 25)	Range		18–39	106–177	60–70	1.40–1.90		1.50–3.73		3.68–6.13	1.80–3.13	0.22–1.15	2.68–4.40
	Median		26	130	65.0	1.64		2.55		5.15	2.50	0.58	3.25
Total female patients (N = 31)	Range	2–157	19–47	76–147	60–72	1.26–1.80	1.36–1.89	0.90–3.27	0.92–3.03	1.97–5.03	0.00–2.79	0.00–0.48	0.00–3.22
	Median	28	28	107	66	1.54	1.63	2.03	1.62	3.77	0.76	0.08	0.96
Females studied before 2 yr. from onset (N = 15)	Range	2–24	19–34	92–133	61.5–67.5	1.33–1.71	1.48–1.89	1.28–2.92	1.15–3.03	2.65–5.03	0.07–2.79	0.00–0.42	0.07–3.22
	Median	10	27	111	65	1.54	1.60	2.21	1.92	4.14	1.12	0.08	1.46
Females studied after 2 yr. from onset (N = 16)	Range	28–157	19–47	76–147	60–72	1.26–1.80	1.36–1.79	0.90–3.27	0.92–2.40	1.97–5.03	0.00–2.51	0.00–0.48	0.00–2.80
	Median	64	28	105	66.5	1.54	1.65	1.91	1.27	3.30	0.74	0.06	0.82

VOL. 9 1959

The recent development of a reproducible technique to estimate the maximum lung volume above the resting expiratory level[3] and adaptation of methods to measure the functional residual capacity have made possible the estimation of total lung capacity in the presence of muscular paralysis.

It is the purpose of this paper to present studies of total lung capacity and its subdivisions in patients with respiratory muscle paralysis due to poliomyelitis. Duration of illness, anatomic changes during partial respiratory muscular recovery, and other parameters apparently modifying compartition have been examined and are discussed. The large individual variability imposed by the many different patterns and degrees of respiratory muscular involvement also has been delineated.

METHOD

Thirty-one men and 31 women with poliomyelitis were included in this study.* Their ages and physical characteristics are given in Table I. All of them had varying degrees of residual respiratory muscle paralysis following poliomyelitis and had variable tolerance to the effort of natural ventilation. At the moment of study the time from onset of illness ranged from 29 days to 13 years. All of these subjects had received some type of artificial respiration during the acute phase of their disease. All but 4 men and 2 women were still fully or partly dependent upon artificial respiration at the time of the study.

In all instances the following lung compartments were individually determined in sequence: functional residual capacity, inspiratory capacity, and expiratory reserve volume. More adequate estimation of the maximum lung volume above the resting expiratory level was obtained by using a method reported in detail separately.[3] This volume has been found to exceed greatly the remaining natural inspiratory capacity of individuals with respiratory poliomyelitis. In healthy subjects there is good correlation between inspiratory capacity and maximum lung inflation above resting expiratory level obtained with this method ($r = 0.85$ in 24 healthy men and $r = 0.63$ in 19 healthy women).

The determination of lung compartition formed part of an integrated study of respiratory function that also included determinations of gas distribution and mixing patterns, pulmonary and thoracic volume-pressure relationships, and comparative study of pulmonary function during tank-respirator respiration and during unassisted breathing. The multiple determinations were always carried out in the supine position and in the same order: (1) functional residual capacity and study of gas distribution during tank-respirator respiration; (2) determinations of pulmonary and thoracic volume-pressure relationships; (3) estimation of functional residual capacity during unassisted breathing; (4) determinations of inspiratory capacity; (5) expiratory reserve volume; and (6) estimation of maximum lung inflation above resting expiratory level. It is appreciated that these maneuvers may influence one another. For this reason the order of performance was kept constant.

*We should like to acknowledge the assistance of Dr. Kenneth E. Ware, Psychologist, and of John C. McKenzie and Aubrey E. Guthrie, II, medical students, Baylor University College of Medicine. The latter were summer research fellows and were supported by fellowships from The National Foundation.

The functional residual capacity was ascertained by the nitrogen washout technique using 100 per cent oxygen according to Luft's modification[4] of the technique described by Darling[5] for determination of residual volume. In order to secure standardized ventilatory conditions, the patients were subjected first to tank-respirator respiration* at a cycling rate of 15 per minute, and the pressure settings were adjusted to duplicate as closely as possible the predicted values of steady state ventilation according to Radford's nomogram[6] with all the necessary corrections. Attempts to duplicate the predicted values were not always successful, and some of the patients had minute volumes higher than predicted.

The circuit used for this study is depicted in Fig. 1. The system was flushed out thoroughly with oxygen prior to the test. The flushing end point of near 0 per cent nitrogen was easily determined by analyzing with the nitrogen meter† the concentration of nitrogen in the gas contained in the 120-liter Tissot spirometer. Once a complete flushing had been secured, the 5-way valve (indicated as *6* in Fig. 1) was turned to the small circuit in which the air reservoir consisted of a 9-liter Collins respirometer‡ that had all valves removed. This small circuit was flushed with room air until the nitrogen meter indicated equilibration with ambient nitrogen concentrations.

VOL. 9 1959

The patient was connected to this circuit by breathing through a mouthpiece attached to a 2-way inspiration-expiration valve. A tight but not uncomfortable sealing of the nares was obtained with a noseclip. The respiratory movements were recorded on the kymograph of the spirometer. The pressure settings of the tank were then adjusted to obtain a duplicate of the "predicted" tidal volume at a cycling rate of 15 per minute. Changes of nitrogen concentration in the expired air were directly registered by the recording instrument, thus assuring an accurate determination of the initial alveolar fractional nitrogen concentration. The patient breathed through this circuit until a stable resting expiratory level was obtained. At the end of a quiet expiration the valves indicated as *6* and *7* in Fig. 1 were turned manually and simultaneously to connect the inspiratory side of the circuit to a rubber bag reservoir of 100 per cent oxygen and the expiratory side to the large Tissot spirometer. Continuous flow of oxygen into the bag was carefully regulated to avoid overfilling which would result in delivery of oxygen to the patient under a slight positive pressure. Excessive bag inflow was exhausted through a one-way Sadd valve in the bag circuit. The gradually decreasing nitrogen concentrations in the expired air were monitored on the graphic record of the nitrogen meter output (shown as *15* in Fig. 1). Within a variable period of time (usually less than 2 minutes) the nitrogen concentration decreased to about 8 per cent when the sensitivity of the instrument was increased tenfold to obtain an adequate representation of the nitrogen washout at low concentrations. The arbitrary 1 per cent end point of washout thus indicated readily on the expanded scale was reached after an average time of 3.8 minutes. At this point, the valves previously mentioned

*Emerson Tank Respirator manufactured by J. H. Emerson Company, Cambridge, Massachusetts.

†Modified Lilly-Anderson nitrogen meter designed by S. Ekeroot.[7]

‡Collins respirometer is manufactured by Warren E. Collins, Inc., 555 Huntington Avenue, Boston 15, Massachusetts.

were simultaneously returned to the initial position allowing the patient to breathe again through the small closed circuit of the system. This permitted accurate determination of the resting expiratory level at the end of the nitrogen washout and early re-equilibration of alveolar air with room air. To assure complete re-equilibration the 5-way valve was turned to connect the expiratory side with the ambient air, and the inspiratory side of the small circuit was disconnected from the 9-liter spirometer to allow the patient to inhale room air.

The average nitrogen concentration of all of the expired air collected in the large Tissot spirometer during the washout period was determined by flushing a dry sample of the gas contained therein through the nitrogen meter. The exact

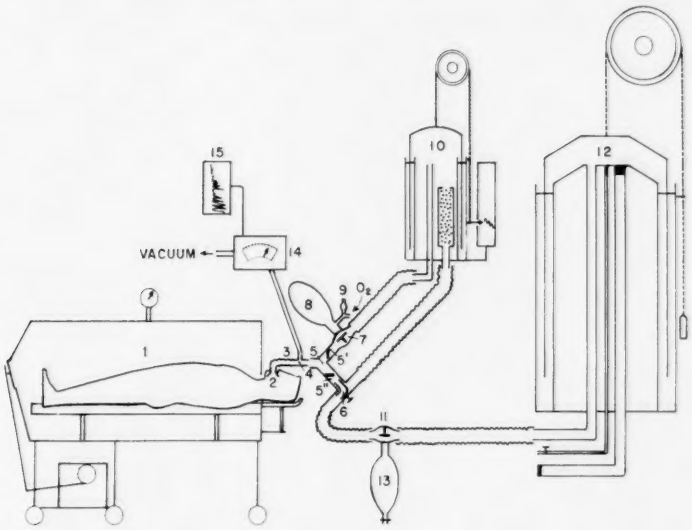

Fig. 1.—Diagrammatic representation of the circuit used for the determination of the functional residual capacity by the nitrogen washout technique.

1, Emerson tank-respirator. *2*, Rubber mouthpiece (13 ml. volume). *3*, Corrugated tubing and plastic connection (46 ml. volume). *4*, Nitrogen valve (25 ml. volume). *5*, Bifurcated portion of a 2-way inspiration-expiration valve (34 ml. volume). *5'*, Inspiratory side of the above valve (10 ml. volume). *5"*, Expiratory side of the above valve (20 ml. volume). *6*, Air conducting part of the 5-way valve (46 ml. volume). *7*, Air conducting part of a 2-way valve (30 ml. volume). *8*, Rubber bag for oxygen. *9*, Sadd valve to avoid overpressurization of the oxygen reservoir. *10*, 9-liter Collins respirometer with the internal valves removed. *11*, Two-way valve. *12*, 120-liter Tissot spirometer. *13*, Rubber bag to assure mixing of air in the Tissot spirometer at the end of the washout. *14*, Nitrogen meter. *15*, Direct recording instrument.

During steady state the patient breathes through the small circuit. At the end of a normal expiration the valves indicated by *6* and *7* are turned manually to connect the patient to the oxygen bag and to the Tissot spirometer. Therefore, all the nitrogen contained in the patient's functional residual capacity and in the instrumental dead space (0.22 L.) will be collected in the Tissot. The portion of tubing between the 5-way valve and the Tissot had been previously flushed with oxygen. The portion of tubing included between the 5-way valve and the bell of the Tissot spirometer was measured and found to be 3.6 L. A small sample of expired air was diverted to the nitrogen meter (*14*) by means of a suction pump. The electrical changes registered by the meter were recorded graphically in a direct recording instrument (*15*), Esterline Angus-Model AW modified for 0.1 second rise time. The bag (*13*) inserted at the connection (*11*) served to provide adequate mixing of the gas contained in the large spirometer (*12*). This bag was bypassed during the procedure. At the end of the washout and after the volume collected in the Tissot had been determined, the valve (*11*) was turned manually and the gas mixture of the spirometer filled the rubber bag which had been emptied previously by suction. Mixing was accomplished by repeated manual squeezing of the rubber bag.

concentration was determined by calibration of the nitrogen meter with dry nitrogen gas mixtures of known concentrations. The exactness of the nitrogen analysis with the meter was found to be within 0.1 volume per cent (1 part per 1,000) by manometric gaseous determinations (Haldane) suitably corrected to dry conditions.

The functional residual capacity was calculated from the total volume of nitrogen that had been retrieved from the lungs by the washout procedure and was converted into BTPS conditions.* Because of the short duration of the total washout time in the patients (average of 3.8 minutes), Cournand's formula for calculation of the body nitrogen excretion[8] could be applied to only one of the patients (Patient L.D. with washout time of 7.1 minutes). This represents a small error of less than 5 per cent lung volume in our calculations of functional residual capacity. The magnitude of this error is not regarded as being highly significant for these purposes.[9,10]

The maximum lung inflation above resting expiratory level was obtained by using the Ventalung† intermittent positive pressure breathing device which provided a continuous flow of a mixture of oxygen and air in concentrations approximating 40 per cent oxygen and 60 per cent room air. Inflation was initiated by slight natural inspiratory effort or in those poliomyelitis subjects still requiring continuous ventilatory assistance, triggering of inflow was produced by the onset of tank respirator initiated respiration. The rate of delivery of air-oxygen mixture ranged from 1.83 to 0.17 L. per second over a pressure range in the delivery system of 1 to 30 cm. H_2O. The amount of air exhaled from the lungs following one of these assisted inspiratory inflating maneuvers was recovered and measured in a 9-liter Collins respirometer inserted into a small circuit adapted for the estimation of inspiratory capacity. In each subject as many determinations as necessary were performed to obtain at least one duplicate of the highest value of the volume of gases recovered from the lungs. A duplicate recording of inspiratory capacity and expiratory reserve volume was made in each subject with the

*The formula used for calculation of functional residual capacity was:

$$F.R.C. = \frac{(V_E + 3.60)\ F_{E_{N_2}}}{F_{A_{N_2}}} - 0.22$$

In this formula F.R.C. represents the functional residual capacity; V the total volume of expiried gas collected in the Tissot spirometer at the end of the procedure; $F_{E_{N_2}}$ the fractional concentration in dry gas phase of the total expired nitrogen during the washout procedure; and $F_{A_{N_2}}$ is the fractional concentration of alveolar nitrogen prior to washout (this concentration was found to be 79 to 80 per cent). The value 3.60 L. represents the volume of dead space in the large circuit and was kept constant during this study. It includes the space between the 5-way valve and the bell of the Tissot spirometer. This space was flushed out entirely with oxygen prior to the test. The instrumental dead space between the subject's airway, the oxygen reservoir of the inspiratory side, and the collecting reservoir in the expiratory side was also kept constant during the study. Its volume was 0.22 L. and the concentration of nitrogen therein at the initiation of the washout was 79 to 80 per cent. This fractional volume of nitrogen was collected during the first exhalation in the Tissot spirometer and subtracted from the nitrogen volume fraction of the functional residual capacity. The volume of the different parts included in the instrumental dead space is indicated in the description of Fig. 1.

†Ventalung manufactured by J. J. Monaghan Co., 500 Alcott St., Denver, Colo.

same spirometer prior to passive inflation. An interval of a few minutes elapsed between these determinations. All of these values are recorded also in BTPS conditions.

In order to compare the poliomyelitis subjects' values with the lung compartments obtained in healthy subjects, 25 healthy adult men and 25 healthy adult women were also studied in the supine position using the same technique and with the same apparatus. They included physicians, medical students, nurses, and hospital orderlies. They were selected so that insofar as possible age and height were comparable to those of the poliomyelitis subjects (Table I). Their state of health was assessed from a clinical history and by radiologic examination and they were found to be free of respiratory disease. The following lung compartments were investigated: functional residual capacity, inspiratory capacity, and expiratory reserve volume. Functional residual capacity was studied during quiet natural breathing in the supine position; inspiratory capacity and expiratory reserve volume were determined from duplicate spirometric readings in the same position at the end of the experiment.

OL.
9
959

Two successive determinations were performed in 29 patients to determine if artificial respiration influenced the functional residual capacity since the values obtained in patients were during tank-respirator respiration and those obtained in health were during natural breathing. These subjects (14 men and 15 women) had varying degrees of respiratory muscle paralysis but were also able to tolerate unassisted breathing for the duration of the washout test. The functional residual capacity was determined first during tank-respirator respiration under the conditions described. Artificial respiration was discontinued after completion of the washout. The patient was allowed to maintain a steady resting expiratory level and re-equilibrate lung gases with room air, and then a new determination of the functional residual capacity was obtained during unassisted breathing.

The reliability of this method of measurement of functional residual capacity was established from duplicate determinations carried out successively in 23 supine healthy subjects. The standard error of measurement expressed in percentage of the mean value was found to be 6 per cent.

To permit direct comparisons between functional residual capacity and height, values on these two variables for the patients were reduced to a common scale by transforming measurements on each distribution into standard scores. The formula used was:

$$T = \frac{10\ (X - M.)}{S.D.} + 50,$$

where T is the standard score, X is a measurement on a given variable for a particular patient, and M. and S. D. are the mean and standard deviation of the distribution on that variable obtained in the healthy subjects of the same sex. The transformation of a particular measurement on a patient into its T-score equivalent resulted in a value representing the position of the original measurement in relation to the distribution of values in the healthy series. The attempt

to establish a comparison between functional respiratory capacity and height of the poliomyelitis patients is justified by the correlation found in health between these two variables.[11-13] Although other physical characteristics have been found to correlate with functional residual capacity also (e.g., body surface area, chest circumference, and "radiologic chest volume"), they could not be used for comparison in the poliomyelitis subjects because of the effect that the disease process has upon all the physical characteristics with the exception of height if at the time of onset the patient has completed his statural growth.

RESULTS

The results obtained in the healthy subjects are summarized in Table I and detailed in Table II. The rank order of the subjects in Table II is according to the magnitude of their functional residual capacity in decreasing order. The values of total lung capacity for these healthy subjects were found to be comparable to those obtained by Luft,[4,14] who used a similar method for the determination of functional residual capacity. Inasmuch as the total lung capacity is not expected to change considerably in various body positions, there is reasonable agreement between the values obtained in this series of 50 supine men and women and those obtained in Luft's larger series of sitting subjects who had a greater age span as can be seen in Table III.

Birath,[19] Needham,[20] Marshall,[21] Hickam,[22] and Binger[23] in separate studies with different methods have also reported values of total lung capacity of the order of magnitude we are reporting here. The subjects included in our study were restricted to a relatively narrow age range of 19 to 38 years and had comparable ranges of body surface area. The distribution of values of this series is less wide than in other published series (Table III). It would be improper to compare different authors' series until many possible parameters were identical, especially those affecting or related to the geometric dimensions of the thoracic compartment, e.g., height. Discrepancies due to the different methods used for determination of functional residual capacity have to be considered also. Reported series indicated large differences based upon age, height, and sex. The differences of functional residual capacity values obtained by us in supine subjects and by Luft in sitting individuals using the nitrogen technique of estimation are of comparable magnitude to postural differences reported using helium techniques.[24]

The results obtained in the poliomyelitis subjects are given in detail in Table IV. The patients are ranked according to the value of their functional residual capacity. The ages of these patients are comparable to those of the healthy subjects. They were slightly taller. The loss of weight due to muscular atrophy and nutritional disturbances that accompany the disease process is the determining factor in the low body surface area values. If the pre-illness weight of the patient is taken into consideration, there is greater comparability of the physical characteristics of the two groups.

The values of the lung compartments in the poliomyelitis subjects are more variable than the values obtained in health and it is difficult to make assumptions

VOL 9 195

regarding the form of the distribution of such values in a patient population. For this reason, medians and ranges are more representative of central tendency and dispersion of the data than are means and standard deviations. The median values and range of the lung compartments studied in the patient series are

TABLE II. INDIVIDUAL PHYSICAL CHARACTERISTICS AND LUNG COMPARTMENT VALUES OF HEALTHY SUBJECTS

RANK	SUBJECT	AGE (YR.)	WEIGHT (LB.)	HEIGHT (IN.)	B.S.A. (SQ. M.)	F.R.C. (L.)	I.C. (L.)	T.L.C. (L.)	E.R.V. (L.)	R.V. (L.)	V.C. (L.)
Men											
1	H.V.	23	165	72.5	1.97	3.75	4.24	7.99	1.25	2.50	5.22
2	K.W.	38	160	69.5	1.89	3.70	3.89	7.59	1.13	2.57	4.83
3	G.McD.	25	137	68.0	1.72	3.70	3.09	6.79	1.25	2.45	4.34
4	J.C.	23	190	72.0	2.09	3.57	4.80	8.37	0.87	2.70	5.73
5	J.F.	19	155	71.0	1.89	3.53	3.49	7.02	0.87	2.66	4.60
6	A.G.	25	188	70.5	2.03	3.52	4.23	7.75	2.00	1.52	5.23
7	R.J.	32	197	73.2	2.14	3.52	4.02	7.54	0.43	3.09	4.34
8	N.T.	26	138	68.0	1.77	3.39	3.86	7.25	1.12	2.27	5.10
9	J.M.	22	170	68.5	1.91	3.37	4.47	7.84	1.30	2.07	5.77
10	Y.M.	28	130	68.0	1.71	3.30	3.87	7.17	1.20	2.10	5.07
11	R.C.	24	165	70.0	1.92	3.27	3.52	6.79	0.97	2.30	5.20
12	G.H.	35	135	67.0	1.71	3.14	3.67	6.81	1.19	1.95	4.86
13	J.M.	27	150	68.0	1.82	3.11	2.65	5.76	0.76	2.35	3.57
14	J.J.	28	145	68.5	1.79	3.10	2.70	5.80	1.00	2.10	3.72
15	C.V.	30	163	69.5	1.91	3.06	4.01	7.07	1.14	2.12	4.96
16	R.S.	36	175	71.0	2.00	3.00	4.02	7.02	0.97	2.03	4.99
17	J.McK.	23	200	73.5	2.16	2.85	4.39	7.24	1.08	1.77	5.28
18	B.S.	27	165	71.5	1.95	2.75	4.23	6.98	0.75	2.00	5.28
19	H.M.	30	150	73.0	1.90	2.57	3.98	6.55	1.18	1.33	5.16
20	R.M.	25	155	67.0	1.81	2.43	4.07	6.50	0.42	2.01	4.54
21	W.B.	24	162	69.5	1.90	2.40	3.22	5.62	0.64	1.76	3.89
22	A.K.	27	195	70.5	2.08	2.30	4.89	7.19	0.53	1.77	5.39
23	S.J.	24	155	66.0	1.79	2.11	2.95	5.05	0.64	1.47	3.59
24	L.H.	21	151	66.0	1.77	1.95	2.87	4.82	0.41	1.54	3.19
25	L.P.	32	165	63.0	1.78	1.84	3.09	4.93	0.27	1.57	3.42
Women											
1	G.L.	28	115	63.5	1.53	3.73	2.40	6.13	0.64	3.09	2.83
2	M.D.	30	140	68.0	1.51	3.15	2.52	5.49	0.82	2.33	3.34
3	J.H.	26	116	66.0	1.58	3.14	2.59	6.00	0.92	2.22	3.67
4	C.W.	20	121	67.5	1.64	3.05	2.28	5.33	0.87	2.18	3.26
5	B.C.	29	110	63.0	1.50	3.00	2.57	5.57	0.65	2.35	3.58
6	O.G.	19	125	64.0	1.60	2.94	2.46	5.40	0.87	2.07	3.27
7	J.W.	26	128	65.5	1.64	2.88	2.74	5.62	0.43	2.45	3.63
8	J.A.	19	137	65.5	1.69	2.87	2.30	5.17	0.65	2.22	3.67
9	L.P.	25	131	65.0	1.64	2.75	2.56	5.25	0.57	2.18	3.25
10	E.M.	30	100	60.0	1.40	2.65	2.50	5.15	0.48	2.17	2.98
11	P.C.	25	130	67.5	1.68	2.61	3.00	5.61	0.81	1.80	4.40
12	M.C.	24	116	64.0	1.56	2.56	2.48	5.04	0.65	1.91	3.13
13	G.S.	24	150	65.5	1.76	2.55	2.50	5.05	1.15	1.40	3.65
14	B.H.	21	136	70.0	1.76	2.53	3.13	5.66	0.65	1.88	3.72
15	M.P.	35	145	66.0	1.74	2.52	2.50	5.02	0.58	1.94	3.29
16	E.S.	19	145	64.5	1.71	2.50	2.66	5.16	0.38	2.12	3.01
17	D.I.	35	155	64.5	1.76	2.27	2.00	4.27	0.58	1.69	2.68
18	E.W.	38	155	67.0	1.81	2.25	2.54	4.74	0.34	1.91	3.25
19	V.V.	27	130	67.0	1.69	2.23	1.80	4.03	0.70	1.53	3.40
20	W.T.	31	177	66.0	1.90	2.13	2.50	4.63	0.64	1.49	3.14
21	L.A.	39	136	61.0	1.60	2.03	2.87	4.90	0.35	1.68	3.22
22	L.B.	23	106	61.0	1.44	2.00	2.43	4.43	0.39	1.61	2.91
23	R.C.	25	126	63.0	1.58	1.83	2.45	4.28	0.22	1.61	2.70
24	R.H.	18	130	65.0	1.64	1.58	2.10	3.68	0.43	1.15	2.69
25	M.B.	26	155	64.0	1.75	1.50	2.90	4.40	0.51	0.99	3.27

TABLE III. VALUES OF LUNG COMPARTMENTS IN HEALTHY ADULTS REPORTED BY DIFFERENT AUTHORS

YEAR	AUTHOR	METHOD	NUMBER OF SUBJECTS	AGE (YR.)	HEIGHT (IN.)		B.S.A. (SQ. M.)		T.L.C. (L.)		F.R.C. (L.)		V.C. (L.)	
					M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D.	M.	S.D
Supine Male														
1933	Hurtado et al.[15]*	O_2 dilution	50	18–30	69.2	2.1	1.87	0.12	5.97	0.81	2.18	0.50	4.78	0.59
1938	Kaltreider et al.[16]	O_2 dilution	50	38–63	67.1	2.9	1.82	0.17	5.37	0.84	2.00	0.50	4.07	0.62
1938	Kaltreider et al.[16]	O_2 dilution	10	40–51	——	——	——	——	5.29	——	1.95	——	4.11	——
1950	Whitfield et al.[12]	Closed circuit He dilution	38	13–65	66.7	3.1	1.71	——	5.43	0.74	2.44	0.67	3.98	0.98
1959	Authors	Open circuit N_2 washout with O_2	25	19–38	69.4	2.5	1.90	0.13	6.78	0.94	3.01	0.55	4.69	0.73
Supine Female														
1934	Hurtado et al.[17]	O_2 dilution	50	18–34	64.3	1.7	1.60	0.14	4.24	0.57	1.82	0.39	3.14	0.41
1950	Whitfield et al.[12]	Closed circuit constant volume H_2 dilution	16	12–62	64.3	2.4	1.56	——	4.32	0.55	1.86	0.43	3.13	0.52
1959	Authors	Open circuit N_2 washout with O_2	25	18–39	65.0	2.4	1.64	0.12	5.04	0.61	2.53	0.51	3.28	0.38

VOL. 9 1959

POL.
9
959

Sitting Male														
1938	Kaltreider et al.[16]	O_2 dilution	10	40–51	—	—	—	—	5.92	—	2.92	—	4.30	—
1939	Aslett et al.[18]	O_2 dilution (no BTPS correction)	66	19–63	65.8	2.3	1.71	0.13	5.42	0.84	2.92	0.60	3.80	0.55
1944	Birath[19]	Closed circuit H_2 dilution	16	18–39	—	—	—	—	6.57	0.61	3.18	0.45	5.08	0.48
1950	Whitfield et al.[12]	Closed circuit He dilution	58	13–69	66.8	3.0	1.72	—	5.74	1.02	3.02	0.77	4.00	0.83
1954	Needham et al.[20]	Closed circuit He dilution (no BTPS correction)	102	20–70	67.8	2.5	1.81	0.14	6.23	0.83	3.33	0.68	4.13	0.75
1955	Luft et al.[4]	Open circuit N_2 washout with O_2	25	12–64	—	—	—	—	6.69	1.13	3.47	—	—	—
1956	Luft et al.[14]	Open circuit N_2 washout with O_2	29	21–30	—	—	—	—	6.71	0.95	—	—	—	—
			52	31–40	—	—	—	—	6.90	1.12	—	—	—	—
			42	41–50	—	—	—	—	6.71	0.92	—	—	—	—
			22	51–65	—	—	—	—	6.60	0.85	—	—	—	—
1957	Marshall[21]	Closed circuit He dilution	37	19–43	71.1	3.3	1.91	0.17	7.27	1.61	3.72	0.89	5.34	0.93
1958	Hickam et al.[22]	Open circuit N_2 washout with O_2	11	21–29	—	—	—	—	6.44	0.40	3.34	0.31	5.02	—
Sitting Female														
1944	Birath[19]	Closed circuit H_2 dilution	19	18–39	—	—	—	—	4.79	0.63	2.22	0.49	3.57	0.44
1950	Whitfield et al.[12]	Closed circuit He dilution	31	12–68	63.1	3.3	1.56	—	4.31	0.71	2.32	0.49	2.88	0.56
1954	Needham et al.	Closed circuit He dilution (no BTPS correction)	66	20–70	63.0	2.3	1.60	0.14	4.33	0.62	2.30	0.49	2.76	0.54
1955	Luft et al.[4]	Open circuit N_2 washout	12	12–64	—	—	—	—	4.87	0.59	2.67	—	—	—
1957	Marshall[21]	Closed circuit He dilution	8	19–28	63.2	—	1.55	—	4.46	—	2.39	—	3.00	—

*Original values corrected by Kaltreider.[14]
Series of lung compartment values indicating the functional residual capacity at mid-inspiratory position have been excluded from this table.

TABLE IV. INDIVIDUAL PHYSICAL CHARACTERISTICS AND LUNG COMPARTMENT VALUES OF POLIOMYELITIS SUBJECTS

RANK	SUBJECT	AGE (YR.)	TIME FROM ONSET (MO.)	WEIGHT (LB.)	HEIGHT (IN.)	B.S.A. (SQ. M.)	PRE-ILLNESS B.S.A. (SQ. M.)	F.R.C. (L.)	ESTI-MATED I.C. (L.)	T.L.C. (L.)	NATURAL I.C. (L.)	E.R.V. (L.)	V.C. (L.)
Men													
1	D.J.	27	84	87	74.0	1.51	1.88	4.56	1.46	6.02	0.87	0.00	0.87
2	H.W.	29	1	150	70.5	1.84	1.92	4.31	3.30	7.69	3.01	0.69	3.70
3	L.D.	30	46	167	69.0	1.91	1.91	3.60	1.60	5.20	0.86	0.00	0.86
4	R.F.	34	74	119	71.0	1.71	1.94	3.57	2.37	5.94	0.42	0.00	0.42
5	J.S.	19	1	159	70.0	1.87	1.87	3.31	2.00	5.31	0.20	0.00	0.20
6	M.W.	38	18	127	74.0	1.79	2.01	3.30	2.32	5.62	0.71	0.55	1.27
7	E.R.	33	5	140	72.0	1.82	1.90	3.29	2.73	6.02	1.41	0.47	1.88
8	C.W.	31	64	156	75.0	1.93	2.10	3.22	0.85	4.07	0.30	0.00	0.30
9	J.W.	27	1	157	71.0	1.89	2.03	3.00	——	4.91*	1.91	0.43	2.34
10	A.W.	23	1	175	71.0	1.97	1.97	2.96	2.11	5.07	0.13	0.00	0.13
11	D.J.	22	11	110	70.5	1.64	1.84	2.95	2.40	5.35	0.76	0.40	0.80
12	M.S.	29	12	120	70.0	1.68	1.91	2.93	1.52	4.45	0.76	0.16	0.92
13	H.T.	22	71	162	74.0	2.00	2.06	2.93	4.22	7.15	3.72	0.00	3.72
14	R.Fl.	27	62	93	63.5	1.40	1.64	2.81	2.07	4.88	1.70	0.37	2.07
15	G.K.	23	15	115	74.0	1.70	2.17	2.81	2.42	5.23	0.84	0.04	0.88
16	J.O.	23	2	168	73.0	1.97	2.13	2.74	2.87	5.61	2.56	0.51	3.07
17	D.R.	23	79	124	70.0	1.70	1.85	2.71	1.92	4.63	1.31	0.10	1.41
18	C.B.	33	47	170	73.5	2.01	2.30	2.70	2.65	5.35	1.60	0.07	1.67
19	F.C.	33	3	155	70.5	1.88	2.10	2.44	2.80	5.24	1.60	0.27	1.87
20	C.S.	24	13	107	70.0	1.59	1.84	2.43	2.11	4.55	1.36	0.27	1.63
21	J.R.	22	18	118	70.5	1.67	1.87	2.39	1.83	4.22	1.10	0.10	1.20
22	B.L.	23	29	119	69.0	1.62	1.80	2.37	1.34	3.71	0.50	0.00	0.50
23	H.Wh.	42	5	128	69.5	1.70	1.92	2.33	1.79	4.12	1.10	0.06	1.16
24	R.B.	24	14	135	68.0	1.72	1.80	2.33	2.61	4.93	2.15	0.10	2.25
25	R.H.	33	33	160	71.0	1.90	1.90	2.31	2.84	5.31*	3.00	0.45	3.45
26	E.R.	29	88	119	68.0	1.64	1.87	2.25	1.73	3.98	0.70	0.05	0.75
27	S.E.	24	72	138	69.0	1.77	1.98	2.14	2.33	4.47	1.91	0.42	2.33
28	S.L.	33	46	155	72.0	1.92	2.07	1.98	1.38	3.36	0.53	0.05	0.58
29	F.R.	28	135	140	74.5	1.87	1.85	1.80	1.72	3.74*	1.94	0.27	2.09
30	V.F.	26	7	136	70.0	1.77	1.87	1.76	1.90	3.66	0.87	0.37	1.24
31	J.Se.	20	70	98	71.0	1.54	——	1.73	1.80	3.53	1.09	0.20	1.29

VOL. 9 1959

Women													
1	B.H.	29	43	76	62.0	1.26	1.49	3.27	1.27	4.54	0.31	0.00	0.31
2	V.E.	28	24	95	67.5	1.67	1.61	2.92	1.92	4.84	1.15	0.03	1.18
3	R.B.	26	12	107	66.5	1.54	1.64	2.92	1.35	4.27	0.40	0.02	0.41
4	R.G.	28	28	112	72.0	1.65	1.78	2.71	——	5.03*	2.32	0.48	2.80
5	B.S.	23	10	92	65.0	1.42	1.54	2.60	1.62	4.22	1.08	0.08	2.16
6	J.W.	26	2	132	67.5	1.71	1.88	2.56	1.35	3.91	0.65	0.08	2.76
7	L.K.	33	2	98	61.5	1.39	1.48	2.46	2.20	4.66	0.40	0.10	0.55
8	S.M.	34	6	115	62.0	1.50	1.53	2.30	2.30	4.60	1.87	0.33	2.20
9	M.M.	33	12	119	67.0	1.61	1.89	2.29	2.09	4.38	1.12	0.02	1.14
10	M.F.	21	119	115	69.0	1.64	——	2.25	2.03	4.28	2.07	0.16	2.23
11	D.P.	27	8	109	66.0	1.56	1.73	2.21	2.62	4.83	2.30	0.30	2.54
12	B.L.	20	3	115	64.0	1.53	1.60	2.17	1.97	4.14	1.73	0.35	2.08
13	L.B.	34	81	105	66.0	1.53	1.64	2.09	0.92	3.01	0.35	0.00	0.35
14	D.M.	38	157	108	68.0	1.57	1.65	2.08	1.67	3.75	1.13	0.02	1.15
15	M.D.	47	70	79	60.0	1.26	1.36	2.06	1.19	3.25	0.62	0.13	0.75
16	B.Lo.	24	78	95	69.0	1.51	1.62	2.03	1.17	3.20	0.73	0.08	0.81
17	B.B.	28	10	133	65.5	1.67	1.67	2.00	3.09	5.09	2.79	0.42	3.22
18	A.P.	19	54	104	70.0	1.58	1.77	1.98	1.81	3.79	0.00	0.00	0.00
19	R.M.	29	48	103	66.0	1.51	1.65	1.84	1.52	3.36	0.76	0.11	0.86
20	M.D.	23	5	121	64.0	1.58	1.64	1.80	2.08	3.88	1.33	0.13	1.46
21	B.Br.	28	49	105	68.0	1.55	1.78	1.70	1.24	2.93	0.96	0.00	0.96
22	S.T.	22	57	141	70.0	1.80	1.77	1.70	2.01	3.71	1.70	0.06	1.76
23	N.W.	28	71	99	64.0	1.43	1.52	1.61	1.26	2.87	0.30	0.08	0.37
24	F.S.	20	13	104	64.0	1.48	1.48	1.49	1.15	2.65	0.33	0.04	0.34
25	L.A.	31	22	111	62.5	1.51	1.51	1.47	1.60	3.07	0.07	0.00	0.07
26	T.V.	37	51	107	65.0	1.52	1.59	1.44	2.40	3.95*	2.51	0.24	2.75
27	C.B.	19	8	124	63.0	1.57	1.59	1.43	1.62	3.05	1.62	0.20	1.84
28	B.C.	33	12	107	65.0	1.52	1.58	1.28	1.65	2.94	0.27	0.00	0.27
29	B.G.	32	81	115	66.0	1.60	1.66	1.26	1.30	2.56	0.50	0.05	0.55
30	M.S.	45	45	147	67.0	1.73	1.79	1.02	1.15	2.17	0.75	0.07	0.82
31	P.M.	22	73	100	63.0	1.45	1.60	0.90	1.07	1.97	0.50	0.05	0.55

*In these patients the T.L.C. was calculated by adding the natural I.C. to the F.R.C. In all the other patients the T.L.C. was calculated by adding the estimated I.C. to the F.R.C.

presented in Table I. The low median values of all the lung compartments of the poliomyelitis patients in relation to the healthy subjects contrasts with the comparability of their pre-illness physical characteristics. This takes on greater significance if the patient group is divided into two major categories according to the time of the study in relation to the onset of paralysis. A time limit of 24 months after onset was used as a division. Those patients studied before that time have been grouped separately from those studied thereafter.

The values of functional residual capacity of the patients were obtained during tank-respirator respiration. Comparison with the values obtained in health during natural respiration is justified by the small difference found between functional residual capacity values obtained in the same subject during tank-respirator respiration and during natural breathing. In a group of 14 men the mean functional residual capacity during tank-respirator respiration was 2.80 L. (standard deviation, 0.74 L.), while during unassisted respiration it was also 2.80 L. (standard deviation, 0.68 L.). In a group of 15 women the values were 1.86 L. (standard deviation, 0.42 L.) and 1.97 L. (standard deviation, 0.37 L.), respectively. The difference of mean values of functional residual capacity in this group of women is 1 standard error of the method of measuring functional residual capacity.

TABLE V. MEDIAN AND RANGE OF STANDARD (T) SCORES* ON HEIGHT AND F.R.C. FOR THE PATIENT GROUPS AND PROBABILITIES OF OBTAINED DIFFERENCES BETWEEN STANDARD SCORES ON HEIGHT AND STANDARD SCORES ON F.R.C.

SUBJECT GROUP	HEIGHT		F.R.C.		p
	MEDIAN	RANGE	MEDIAN	RANGE	
Men					
0-2 years post-illness (N = 16)	54.4	44.4–68.4	47.5	27.3–73.6	< 0.005
Over 2 years post-illness (N = 15)	56.4	26.4–72.4	44.4	26.7–78.2	0.015
Women					
0-2 years post-illness (N = 15)	50.0	35.4–60.4	43.7	25.5–57.6	< 0.01
Over 2 years post-illness (N = 16)	56.2	29.2–79.2	37.8	18.0–64.5	< 0.005

*T-score distributions have a mean of 50 and a standard deviation of 10. In the present application where values for healthy subjects were used as the basis for derivation, a T-score of 65 on height, for example, signifies a measurement that is 1.5 standard deviations above the mean height for the healthy group of the same sex. Similarly, a T-score of 40 for F.R.C. corresponds to a value which is one standard deviation below the mean F.R.C. obtained on the healthy subjects.

Medians and ranges of standard scores in height and functional residual capacity for the patients are presented in Table V. With one exception the median height for patient groups exceeded the mean and median height for the healthy subjects of like sex. Median height for the women studied before 2

years from onset coincided with the mean for healthy women. In spite of their greater height, however, the median functional residual capacity for all the patient groups was lower than the mean and median for the healthy subjects. In every group the median score for height exceeds the median score for functional residual capacity. Additional importance may be attached to the fact that the deficit in functional residual capacity in relation to height was shown to be greater for patients studied after 2 years from onset.

Table V shows, too, the chance probabilities associated with the occurrence of obtained differences between paired standard scores for individuals. They were determined by use of the paired replicates test[25] for a one-tailed region of rejection. Since the probability of chance occurrence is extremely small in every group, it may be concluded that standard scores for functional residual capacity were significantly lower than standard scores for height.

OL.
9
959

DISCUSSION

The data indicate that the estimated total lung capacity of the poliomyelitis subjects in general is reduced. This appears to be related to the large reduction in the maximum lung volume above the resting expiratory level used to estimate inspiratory capacity coupled with generally smaller than average functional residual capacities. The functional residual capacity is frequently in the lower range of that expected to occur in health since the poliomyelitis subjects' mean and median values were below the mean and median of control healthy subjects of comparable age. A comparison of the reported compartition values to those found in healthy subjects was undertaken to afford a more valid comparison than could be obtained from the literature where varied or unknown physical characteristics and different methods of determination had been used. If the height of the slightly taller poliomyelitis subjects is also taken into account in contrasting functional residual capacities, these low groupings take on added significance (Table V).

Explanation of the findings described here requires enumeration of a variety of factors in addition to those included in the tabular comparisons. Multiple correlations are needed to fully reveal and quantitate the many factors that must certainly play a part in the observed reduction of total lung capacity. Alterations of lung compartition in general tend to follow the duration of illness, the magnitude of the respiratory muscle paralysis, and the prolonged use of artificial respiratory assistance.

The duration and magnitude of respiratory paralysis obviously has contributed to the decrease in functional residual capacity. The occurrence of marked changes in the anatomic conformity of the thoracic compartment of chronic poliomyelitis patients is commonly known to the clinical observer. The natural history of this condition often indicates the action of deforming forces that produce obvious changes in the configuration of the thoracic boundaries. The thoracic cage of these individuals is frequently misshapen and asymmetrical, particularly in the presence of partial respiratory muscle paralysis or long-standing use of breathing aids and prolonged supine body positioning. In ad-

dition some patients subjected to long-term cuirass-respirator respiration develop a large anterior bulging of the rib cage when there is extensive intercostal muscle paralysis. This may follow the general conformity of the cuirass shell itself (Fig. 2). These deforming forces can produce severe alterations in anatomic conformation during periods of bodily growth. A curvature of the vertebral column may be found in some instances and this accentuates the remarkable changes in the shape of the thoracic cage.

Fig. 2.—Anterior view of the chest of a patient with respiratory muscle paralysis requiring artificial respiration. This 24-year-old man (height 71 inches) had the onset of poliomyelitis in October, 1952. He is a quadriplegic and his spontaneous vital capacity is zero. He is totally dependent on cuirass-respirator (Monaghan) respiration using negative pressure settings of −20 to −25 cm. H_2O and at a rate of 18 cycles per minute. Adequate ventilation during the time this photograph was taken was secured by glossopharyngeal breathing. Pulmonary lung compartition studies were obtained 6 years after onset of poliomyelitis and within one week of this photograph. The following values of lung compartments were observed: F.R.C., 1.64 L.; estimated inspiratory capacity (by means of a Ventalung), 2.10 L.; estimated inspiratory capacity (by means of glossopharyngeal breathing), 2.00 L.; vital capacity, 0.00 L. (all values BTPS). The deformity of the chest follows the configuration of the cuirass shell of the respirator. The circumference of the chest at midsternum was 92 cm. at end of expiration and 94 cm. at maximum inflation by glossopharyngeal breathing. The external appearance of the thorax is in direct contrast to the low value of the F.R.C.

The limited range of physical motion and volumetric excursions of the lungs and thorax encountered during respiratory paralysis and artificial respiration may affect the mechanical behavior of the pulmonary and thoracic structures. Decreased "compliance" of the thorax and lungs has already been reported.[26,27] This reduced distensibility may further decrease the possible maximal volumetric excursions of the lungs and thorax.

The interpretation of pulmonary compartition in poliomyelitis subjects should be related also to changes in resting expiratory level which may be indipendent of the absolute volume of the functional residual capacity. The assumption that the normal anatomic interrelationships are preserved if, for example, the functional residual capacity is within healthy volumetric ranges appears to be erroneous. It is entirely possible that the rib cage may go into a partial in-

spiratory position in the presence of intercostal muscle paralysis. When this is combined with diaphragmatic paralysis, a further reduction in the resting volume of the thoracic compartment may occur (visual and radiographic estimations) (Fig. 3). Yet the combination of inspiratory position of the rib cage with expiratory positioning of the diaphragm may yield a functional residual capacity value that is within healthy ranges. A given resting expiratory thoracic volume may occur in a variety of different anatomic or geometric solid forms. Similar situations may develop in the geometry of maximal inspiratory volumes.

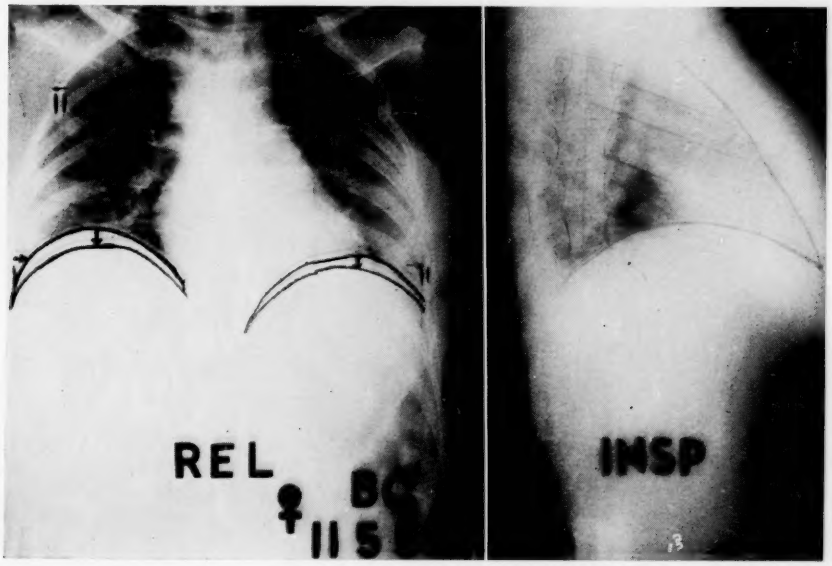

Fig. 3.—Anteroposterior and left lateral radiographic projection of the chest of a patient with respiratory muscle paralysis due to poliomyelitis. These films were obtained with a portable apparatus with the patient in the supine position at resting expiratory level and at the end of a maximum inspiratory effort. The tube was placed at a distance of 6 feet from the table where the patient was lying. The film at the left of this picture was obtained at the resting expiratory level (REL). The heavy lines indicate the relative changes in position of the diaphragm and rib cage after inspiration. The film at the right was obtained in maximum inspiration (INSP). The heavy lines indicate the position of the diaphragm, ribs, and vertebrae. The patient, a 33-year-old woman, had the onset of poliomyelitis with respiratory muscle paralysis 12 months prior to the time of study. She was totally dependent on artificial respiration except for brief periods of unassisted breathing. Pulmonary compartition studies carried out at the time of this radiographic examination yielded the following values: F.R.C., 1.28 L.; T.L.C., 2.94 L.; V.C., 0.27 L. This picture illustrates the relatively high position of the diaphragm and the visually apparent reduction in volume of the thoracic compartment.

The significance of the type of change in compartition reported here as related to the effectiveness of gas exchange and the prediction of suitable minute volumes for steady state ventilation has not been investigated. This deserves renewed interest in view of these findings.

The large variability in the data reported in this study reflects the unpredictable character of disease and recovery processes and emphasizes the importance of serial observations to detect the patient's respiratory status at every stage of illness. More accurate clinical management may result from these

VOL.
9
1959

serial observations. A large number of the patients included in this report are being studied serially on a yearly basis for these reasons.

In conclusion, a comprehensive evaluation of pulmonary function in disease states cannot be obtained by compartition studies alone. They must be correlated with simultaneous studies of the mechanical behavior of the lung-thorax system, studies of lung gas distribution and mixing, analysis of gas diffusion characteristics, and assessments of the pulmonary circulatory functions. In this way a more precise understanding of relatively simple and clinically useful measurements such as compartition may be obtained.

SUMMARY

The supine total lung capacity and its subdivisions has been determined in 62 patients with respiratory muscle paralysis due to poliomyelitis. The results were contrasted with those obtained using the same methods in 50 healthy subjects matched according to age, sex, and physical characteristics. A significant reduction of the total lung capacity was found in the patients. This was accounted for by reductions or alterations in the functional residual capacity and the maximum lung volume above the resting expiratory level. The frequent reduction of functional residual capacity was more marked in the patients studied after 2 years from onset of their illness. Respiratory muscle paralysis, duration of illness, thoracic deformities, and prolonged artificial respiration were considered to be contributory to these lung compartition changes.

VOL 9 195

REFERENCES

1. Ferris, B. G., Jr., Whittenberger, J. L., and Affeldt, J. E.: Pulmonary Function in Convalescent Poliomyelitic Patients. I. Pulmonary Subdivision and Maximum Breathing Capacity, New England J. Med. **246**:919, 1952.
2. Plum, F., and Lukas, D. S.: Evaluation of Cuirass Respirator in Acute Poliomyelitis with Respiratory Insufficiency, Am. J. M. Sc. **221**:417, 1951.
3. Spencer, W. A., and Vallbona, C.: The Estimation of Inspiratory Capacity in Health and in Subjects With Respiratory Muscle Paralysis. J. Appl. Physiol. In press.
4. Luft, U. C., Roorbach, E. H., and MacQuigg, R. E.: Pulmonary Nitrogen Clearance as a Criterion of Ventilatory Efficiency, Am. Rev. Tuberc. **72**:465, 1955.
5. Darling, R. C., Cournand, A., and Richards, D. W., Jr.: Studies on the Intrapulmonary Mixture of Gases. III. An Open Circuit Method for Measuring Residual Air, J. Clin. Invest. **19**:609, 1940.
6. Radford, E. P., Jr., Ferris, B. G., Jr., and Kriete, B. C.: Clinical Use of a Nomogram to Estimate Proper Ventilation During Artificial Respiration, New England J. Med. **251**:877, 1954.
7. Ekeroot, S., and Lundin, G.: Proceedings of the Eighteenth International Physiological Congress, Copenhagen, published in Copenhagen, 1950, page 540.
8. Cournand, A., Yarmush, I. G., and Riley, R. L.: Influence of Body Size on Gaseous Nitrogen Elimination During High Oxygen Breathing, Proc. Soc. Exper. Biol. & Med. **48**:280, 1941.
9. Boothby, W. M., Luft, U. C., and Benson, O. O., Jr.: Gaseous Nitrogen Elimination: Experiments When Breathing Oxygen at Rest and at Work With Comments on Dysbarism, J. Aviat. Med. **23**:141, 1952.
10. Lundin, G.: Nitrogen Elimination During Oxygen Breathing, Acta physiol. scandinav. **30** (Suppl. 111): 130, 1953.
11. Hurtado, A., and Fray, W. W.: Studies of Total Pulmonary Capacity and Its Subdivisions. II. Correlation With Physical and Radiological Measurements, J. Clin. Invest. **12**:807, 1933.
12. Whitfield, A. G. W., Waterhouse, J. A. H., and Arnott, W. M.: The Total Lung Volume and Its Subdivisions. A Study in Physiological Norms. III. Correlation With Other Anthropometric Data, Brit. J. Social Med. **4**:116, 1950.

13. Helliesen, P. J., Cook, C. D., Friedlander, L., and Agathon, S.: Studies of Respiratory Physiology in Children. I. Mechanics of Respiration and Lung Volumes in 85 Normal Children 5 to 17 Years of Age, Pediatrics **22**:80, 1958.
14. Luft, U. C.: Personal communication.
15. Hurtado, A., and Boller, C.: Studies of Total Pulmonary Capacity and Its Subdivisions. I. Normal, Absolute and Relative Values, J. Clin. Invest. **12**:793, 1933.
16. Kaltreider, N. L., Fray, W. W., and Van Zile Hyde, H.: The Effect of Age on the Total Pulmonary Capacity and Its Subdivisions, Am. Rev. Tuberc. **37**:662, 1938.
17. Hurtado, A., Fray, W. W., Kaltreider, N. L., and Brooks, W. D. W.: Studies of Total Pulmonary Capacity and Its Subdivisions. V. Normal Values in Female Subjects, J. Clin. Invest. **13**:169, 1934.
18. Aslett, E. A., D'arcy Hart, P., and McMichael, J.: The Lung Volume and Its Subdivisions in Normal Males, Proc. Roy Soc., London, s.B. **126**:502, 1939.
19. Birath, G.: Lung Volume and Ventilation Efficiency, Acta med. scandinav., Suppl. 154, 1944.
20. Needham, C. D., Rogan, M. C., and McDonald, I.: Normal Standards for Lung Volumes, Intrapulmonary Gas-mixing, and Maximum Breathing Capacity, Thorax **9**:313, 1954.
21. Marshall, R.: The Physical Properties of the Lungs in Relation to the Subdivisions of Lung Volume, Clin. Sc. **16**:507, 1957.
22. Hickam, J. B., and Frayser, R.: A Comparative Study of Intrapulmonary Gas Mixing and Functional Residual Capacity in Pulmonary Emphysema Using Helium and Nitrogen as the Test Gases, J. Clin. Invest. **37**:567, 1958.
23. Binger, C. A. L.: The Lung Volume in Heart Disease, J. Exper. Med. **38**:445, 1923.
24. Whitfield, A. G. W., Waterhouse, J. A. H., and Arnott, W. M.: The Total Lung Volume and Its Subdivisions. A Study in Physiological Norms. II. The Effect of Posture, Brit. J. Social Med. **4**:86, 1950.
25. Wilcoxon, F.: Some Rapid Approximate Statistical Procedures, Stamford, Conn., 1949, American Cyanamid Company.
26. Affeldt, J. E., Whittenberger, J. L., Mead, J., and Ferris, B. G., Jr.: Pulmonary Function in Convalescent Poliomyelitic Patients. II. The Pressure-Volume Relations of the Thorax and Lungs of Chronic Respiratory Patients, New England J. Med. **247**:43, 1952.
27. Ferris, B. G., Jr., Mead, J., Whittenberger, J. L., and Saxton, G. A., Jr.: Pulmonary Function in Convalescent Poliomyelitic Patients. III. Compliance of the Lungs and Thorax, New England J. Med. **247**:390, 1952.

VOL.
9
1959

STATISTICAL ASSOCIATIONS BETWEEN INTERNATIONAL CORONARY HEART DISEASE DEATH RATES AND CERTAIN ENVIRONMENTAL FACTORS

VOL.
9
195

NORMAN JOLLIFFE, M.D., AND MORTON ARCHER, M.S.

NEW YORK, N. Y.

From the Diet and Coronary Heart Disease Study Project, Bureau of Nutrition, Department of Health, City of New York

(Received for publication Nov. 25, 1958)

VITAL statistics showing death rates by country for various classifications of diseases, age, and sex are readily available in the *Annual Epidemiologic and Vital Statistics* of the World Health Organization.[1] The *Food Balance Sheets* of the Food and Agriculture Organization[2] (FAO) present the quantities and types of food available for consumption, both in actual amounts and in calories and nutrients, for many of the countries of the world.*

These publications have provided data for several informative statistical associations between coronary heart disease and some dietary component or combination of components.[3-6] Mann[7] has criticized these attempts to discern a relationship between diet and coronary heart disease by attacking the comparability of the data which form the bases for these associations.

There is no easy path for those who seek definitive answers hidden in the maze of direct and indirect effects inherent in these data. The comparability of the death rates between countries is affected by problems of reporting, classification, administrative procedures, and the general level of medical sophistication. As for the *Food Balance Sheets*, valid comparison between nations is affected by the following considerations: (1) the relative efficiencies of the individual data-gathering systems are not equal; (2) the amount of food available is a residual figure and the final value is therefore subject to the variability affecting all the other factors—production, import, export, animal consumption, nonfood use, and waste; and (3) the dietary data represent food available at the retail level and are therefore not exactly synonymous with consumption figures.

*The dietary data pertain to single years in the interval 1952 through 1955. The death rates pertain to either 1954 or 1955 except for Chile (1952), Italy (1951), and Ceylon (1946).

Despite these shortcomings, the fund of information represented by these data cannot be ignored in the investigation of the epidemiology of coronary heart disease. All too often, these data, as pointed out by Yudkin,[5] have been selectively employed to substantiate one theory or another.

Keys[3] presented a chart which showed the relationship between the proportion of total fat calories available in the national diet and the death rates from degenerative heart disease for men in selected age groups. This chart shows a close association between these two factors; unfortunately, only 6 countries are considered and their choice may not be representative.

This latter point is adequately made by Yerushalmy and Hilleboe.[6] However, although the latter consider all the countries for which adequate data are available, they make the error of disregarding important work in the field[8] which, for more than a year, had served to change the emphasis in this area. The dichotomy of the fats has now been changed from total and animal fat versus vegetable fat to saturated fat versus polyunsaturated fat. Thus, where Keys originally had not considered enough countries, Yerushalmy and Hilleboe did not consider fat quality.

The National Dairy Council[4] reviewed the data for 10 countries and, without any detailed statistical analysis stated " . . . no relationship is apparent between incidence of arteriosclerotic and coronary heart disease and any element of diet listed. . . ." These listed dietary factors consisted of:

1. Total calories
2. Total protein
3. Animal protein
4. Total fat
5. Animal fat
6. Vegetable fat
7. Per cent calories—total fat
8. Per cent calories—animal fat
9. Per cent calories—vegetable fat

Although this list of factors distinguished between the animal and vegetable fats, it too ignored the fundamental difference between the saturated and the polyunsaturated fats. With the conclusion quoted previously, the National Dairy Council dismissed any relationship between total fat or animal fat in national dietaries and coronary heart disease.

Yudkin[5] takes more factors into account than did Yerushalmy and Hilleboe and examines more countries than did Keys or the National Dairy Council. Nevertheless, Yudkin, too, does not correlate mortality with the over-all concept of fat quality (saturated versus polyunsaturated fats), the factor which many feel fits best of all and which has substantial support from nonepidemiologic data.[9]

Aside from indicating promising lines for investigation, epidemiologic data possess another function. They may serve as a check upon hypotheses derived from other sources. For example, in this instance, there should be no major disagreement between a hypothesis and the international food and vital statistics.

Accordingly, the relationship between coronary heart disease and the intake of saturated types of fats as set forth or implied by Bronte-Stewart,[8,9] Kinsell,[10] Sinclair,[11] and others must pass a first rough test by showing general agreement

with these data. In other words, the quality of fat consumed must be an important factor (although not necessarily the most or only important one) in explaining the variations of the coronary heart disease death rate between nations. It may well be that other factors will be discovered which are also important in this respect. However, such other factors will not necessarily play a part in discrediting the quality-of-fat hypothesis since this latter does not rule out other forces.

The United Nations data may thus be analyzed with two main objectives: to indicate additional lines of investigation and to point to agreement or disagreement with current thought, in this instance, the quality-of-fat hypothesis. The present study attempts an analysis of these data keeping these two objectives in mind. Fat quality has been added as a factor in determining associations to check whether or not this hypothesis receives support from this source. In addition, several dietary factors other than fat, as well as some nondietary influences, are considered in order to evaluate their possible effects upon the coronary heart disease rates. The countries studied are substantially the same as those considered by Yerushalmy and Hilleboe[6] with the omission of the Netherlands and Israel. Israel has not been included because, in the decade ending in 1953, over 70 per cent of its population had immigrated from their native lands and environments.[12] The Netherlands has been omitted because the FAO food data are not sufficiently detailed to enable an accurate estimate of the amount or proportion of the saturated-type fat intake of this country.

With these data at our disposal, we may pose the following problem: Given the death rates from group B-26* for men aged 55 to 59 years for the 20 countries, (1) can any of the variations in death rates between the countries be explained by the dietary data; (2) if so, how much of this variation can be explained; (3) what is the relative importance of the various factors entering into the explanation, and (4) what factors other than dietary may be taken into account in order to reduce further the amount of variance left unexplained?

Table I presents the various data compared for the 20 countries under consideration. In addition to class B-26 already mentioned, death rates for classification 420 (arteriosclerotic heart disease) for 14 of these same countries also are available sufficient for study at this time.

Column G is not presented per se in the FAO *Food Balance Sheets*[2] but has been derived from them in two ways†: (1) by totaling the known saturated types,‡ and (2) by subtracting the known polyunsaturated types‡ from the total fat intake. Column H was then determined by subtracting total saturated types of fat in column G from the total dietary fat in column F. The various foods

*ISC category B-26 includes categories 420 (arteriosclerotic heart disease), 421 (chronic endocarditis), and 422 (other degeneration of the heart).

†In only one of the 20 countries considered did these two methods differ by more than 2 per cent. This one case resulted from one classification which could not satisfactorily be allocated to either saturated or unsaturated category. Final results were obtained by averaging the values yielded by the two methods.

‡Classification basis for saturated and unsaturated categories were determined according to chemical composition shown by Hilditch.[13] Illustrative examples of classification of many common foods are presented in Table II.

VOL. 9 1959

TABLE I. DEATH RATES FOR MEN AGED 55 TO 59 YEARS AND ENVIRONMENTAL FACTORS FOR 20 COUNTRIES

COUNTRY	DEATH RATE PER 100,000				AVERAGE TOTAL DAILY CALORIES	COMPONENT AS PER CENT OF TOTAL CALORIES				TELEPHONES PER 100 POPULATION
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(J)	(K)
United States	704.7	660	979.7	1,830	3,070	39.2	33.5	5.7	8.2	35.8
Australia	577.4	516	862.6	1,690	3,160	37.9	34.7	3.2	7.3	18.5
Austria	293.9		545.4	1,780	2,820	31.3	23.9	7.4	5.8	7.7
Belgium	250.1		473.3	1,720	2,980	35.0	24.4	10.6	5.7	10.6
Canada	588.3	550	790.8	1,510	3,130	38.0	35.0	3.0	8.0	27.6
Ceylon	103.4		233.9	1,350	1,980	15.2	11.8	3.4	2.2	0.3
Chile	267.3		569.5	2,440	2,490	19.8	12.0	7.8	4.3	2.2
Denmark	294.8	260	484.9	1,180	3,370	38.3	25.5	12.8	6.1	20.5
Finland	621.7	483	907.6	2,040	3,170	31.1	28.4	2.7	6.8	11.3
France	109.9	106	435.0	1,760	2,850	29.5	20.7	8.8	6.4	7.6
German Federation	313.7	194	502.0	1,570	2,950	35.6	23.0	12.6	5.6	8.3
Italy	226.8	120	459.9	1,450	2,550	22.3	10.5	11.8	3.6	5.4
Japan	122.5	50	612.2	1,810	2,005	7.9	1.4	6.5	2.6	3.8
New Zealand	525.7	492	726.8	1,410	3,370	39.8	37.6	2.2	8.2	25.6
Norway	248.8	210	390.5	1,050	3,130	38.0	17.0	21.0	6.4	17.8
Portugal	107.7		495.6	1,630	2,560	24.5	9.4	15.1	3.9	3.2
Sweden	294.6	216	473.0	1,110	3,070	39.4	28.3	11.1	7.3	31.5
Switzerland	273.0	173	474.2	1,510	3,100	33.6	23.6	10.0	6.6	25.5
United Kingdom	427.5	371	651.8	1,700	3,270	38.4	35.0	3.4	5.9	14.0
Yugoslavia	68.2		149.6	1,800	2,525	19.1	13.2	5.9	2.8	1.0

(A) ISC category B-26 (arteriosclerotic and degenerative heart disease). Values actually used in the correlations were the logarithms of the numbers in this column.[1]

(B) ISC category 420 (arteriosclerotic heart disease).[1]

(C) Combined ISC categories B-22 (vascular lesions affecting the central nervous system), B-25 (chronic rheumatic heart disease), B-26 (arteriosclerotic and degenerative heart disease), B-27 (other diseases of the heart), and B-28 (hypertension with mention of heart disease).[1]

(D) Total death rates.[1]

(E) Average total available daily calories. FAO.[2]

(F) Total fat intake.[2]

(G) Saturated types of fat intake.[2]

(H) Unsaturated types of fat intake.[2]

(J) Animal protein intake.[2]

(K) Telephones per 100 population.[32]

were considered as saturated or polyunsaturated according to which type was preponderant after the oleic acid content was disregarded (Table II).

From the aspect of classification into either saturated or unsaturated categories, it is of interest to note that olive oil appears neutral.[14,15] This oil is of importance in two countries considered here (Italy and Portugal) and this neutrality is supported by correlation analyses where no difference in results was obtained when olive oil was considered as one type or the other. This neutrality of action may be ascribed to its high oleic acid content. Oleic acid is a monoethenoid unsaturated acid and is not considered essential since it may be synthesized by the human body.

TABLE II. CLASSIFICATION BASIS OF TYPICAL FOOD FATS INTO SATURATED OR UNSATURATED TYPES*

FAT SOURCE AND TYPE	PER CENT		
	SATURATED	UNSATURATED	
		POLY†	MONO‡
Saturated			
Egg, chicken	37	11	52
Sheep	52	6	42
Beef	53	6	41
Pig	44	11	45
Cow milk	60	4	36
Cocoabean	51–56	2–3	41–47
Coconut	94	1	5
Lard	39	13	48
Tallow	52–60	3–5	37–43
Monounsaturated			
Olive oil	7–24	5–15	65–86
Polyunsaturated			
Peanut (groundnut)	15–24	19–37	39–66
Linseed	6–16	13–36	55–70
Pecan	5–7	16–25	71–78
Walnut	5–11	60–80	9–35
Safflower	5–10	57–59	13–37
Corn (maize)	11–15	34–61	24–50
Sunflower	8–15	33–73	10–58
Sesame seed	12–16	38–48	35–49
Cotton seed	27	53	20
Barley	12	55	33
Rice	18	35	47
Wheat	15	59	26
Rapeseed	3–10	69–81	14–29
Marine mammals	18–30	70–82	
Marine teleosts	18–28	72–82	

*Fatty acid composition taken from Hilditch.[13]
†Primarily linoleic acid.
‡Oleic acid.

The general type of relationship was investigated by means of scatter diagrams; several examples are shown in Fig. 1. Considerations as to type of data and the number of cases available led to the decision to fit semilogarithmic curves by the method of least squares to the relationship between the B-26 death rates and the other independent factors considered. By plotting the logarithms of the death rates against the independent variables, a similar effect is obtained and the various panels of Fig. 2 show how the associations now appear more linear.

Column A of Table III presents the first order correlation coefficients of death rates (the dependent variable) with each of the associative factors considered, namely: (1) coronary heart disease rate (B-26), (2) total daily calorie intake, (3) total fat intake (percentage of total calories), (4) saturated fat intake (percentage of total calories), (5) unsaturated fat intake (percentage of total calories), (6) animal protein intake (percentage of total calories), (7) age-specific death rate, and (8) telephones per 100 population.

TABLE III. CORRELATION COEFFICIENTS OF B-26 DEATH RATES AND PERCENTAGE OF SATURATED-TYPE FAT INTAKE WITH OTHER FACTORS

COEFFICIENT OF CORRELATION OF B-26 DEATH RATES WITH OTHER FACTORS* (A)	COEFFICIENT OF DETERMINATION OF B-26 DEATH RATES WITH OTHER FACTORS* (B)	COEFFICIENT OF CORRELATION OF PER CENT SATURATED-TYPE FAT WITH OTHER FACTORS* (C)	COEFFICIENT OF MULTIPLE CORRELATION OF B-26 DEATH RATES AND PER CENT SATURATED-TYPE FAT WITH OTHER FACTORS* (D)	COEFFICIENT OF MULTIPLE DETERMINATION OF B-26 DEATH RATES AND PER CENT SATURATED TYPE FAT WITH OTHER FACTORS* (E)
r_{12} 0.5456	r^2_{12} 0.2977	r_{42} 0.7374	$R_{1.42}$ 0.8261	$R^2_{1.42}$ 0.6824
r_{13} 0.7321	r^2_{13} 0.5360	r_{43} 0.8777	$R_{1.43}$ 0.8261	$R^2_{1.43}$ 0.6826
r_{14} 0.8259	r^2_{14} 0.6821	r_{45} −0.4061	$R_{1.45}$ 0.8322	$R^2_{1.45}$ 0.6926
r_{15} −0.3218	r^2_{15} 0.1036	r_{46} 0.8751	$R_{1.46}$ 0.8417	$R^2_{1.46}$ 0.7084
r_{16} 0.8016	r^2_{16} 0.6426	r_{47} −0.3665	$R_{1.47}$ 0.8263	$R^2_{1.47}$ 0.6828
r_{17} −0.2815	r^2_{17} 0.0792	r_{48} 0.7483	$R_{1.48}$ 0.8335	$R^2_{1.48}$ 0.6948
r_{18} 0.6901	r^2_{18} 0.4762			

Critical values of r:	α = 0.05	0.01
	0.444	0.561
R:	0.545	0.647

*Subscripts refer to various factors as follows:

1 Death rate per 100,000 men, aged 55 to 59 years, 20 countries (ISC B-26).
2 Total daily calorie intake.
3 Total fat intake as percentage of total calories.
4 Saturated types of fat intake as percentage of total calories.
5 Unsaturated types of fat intake as percentage of total calories.
6 Animal protein intake as percentage of total calories.
7 General death rate per 100,000 men, aged 55 to 59 years.
8 Telephones per 100 population.

According to this numbering scheme, r_{14} in column A would represent the simple correlation between factors 1 and 4, a measure of the association between coronary heart disease and the percentage intake of saturated types of fat. Column B of Table III indicates what proportion of the variance in the death rates is explained by variations in the independent variable under consideration.

The highest correlation with death rate is obtained in its association with the intake of saturated types of fat, 0.8259. However, high correlations also exist with some of the other variables (e.g., animal protein [r_{16}], 0.8016; total fat as a percentage of total calories [r_{13}], 0.7321). Furthermore, significant percentages of the variance in the death rates (column B) can also be explained by these latter variables. Which, then, of these factors is the most important?

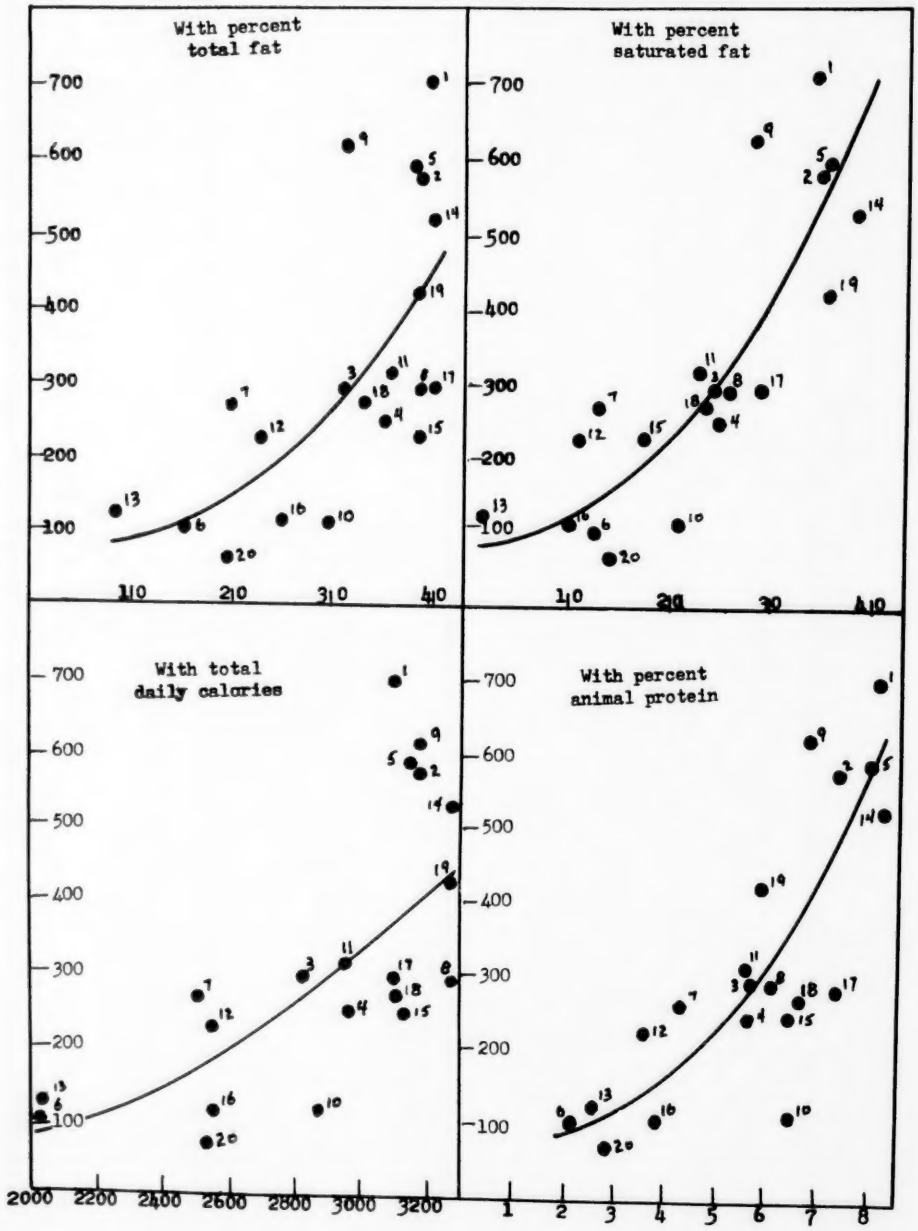

Fig. 1.—Association of B-26 death rates with the intakes of various dietary components. Arithmetic plot. Key to countries: *1*, United States; *2*, Australia; *3*, Austria; *4*, Belgium; *5*, Canada; *6*, Ceylon; *7*, Chile; *8*, Denmark; *9*, Finland; *10*, France; *11*, German Federation; *12*, Italy; *13*, Japan; *14*, New Zealand; *15*, Norway; *16*, Portugal; *17*, Sweden; *18*, Switzerland; *19*, United Kingdom; *20*, Yugoslavia.

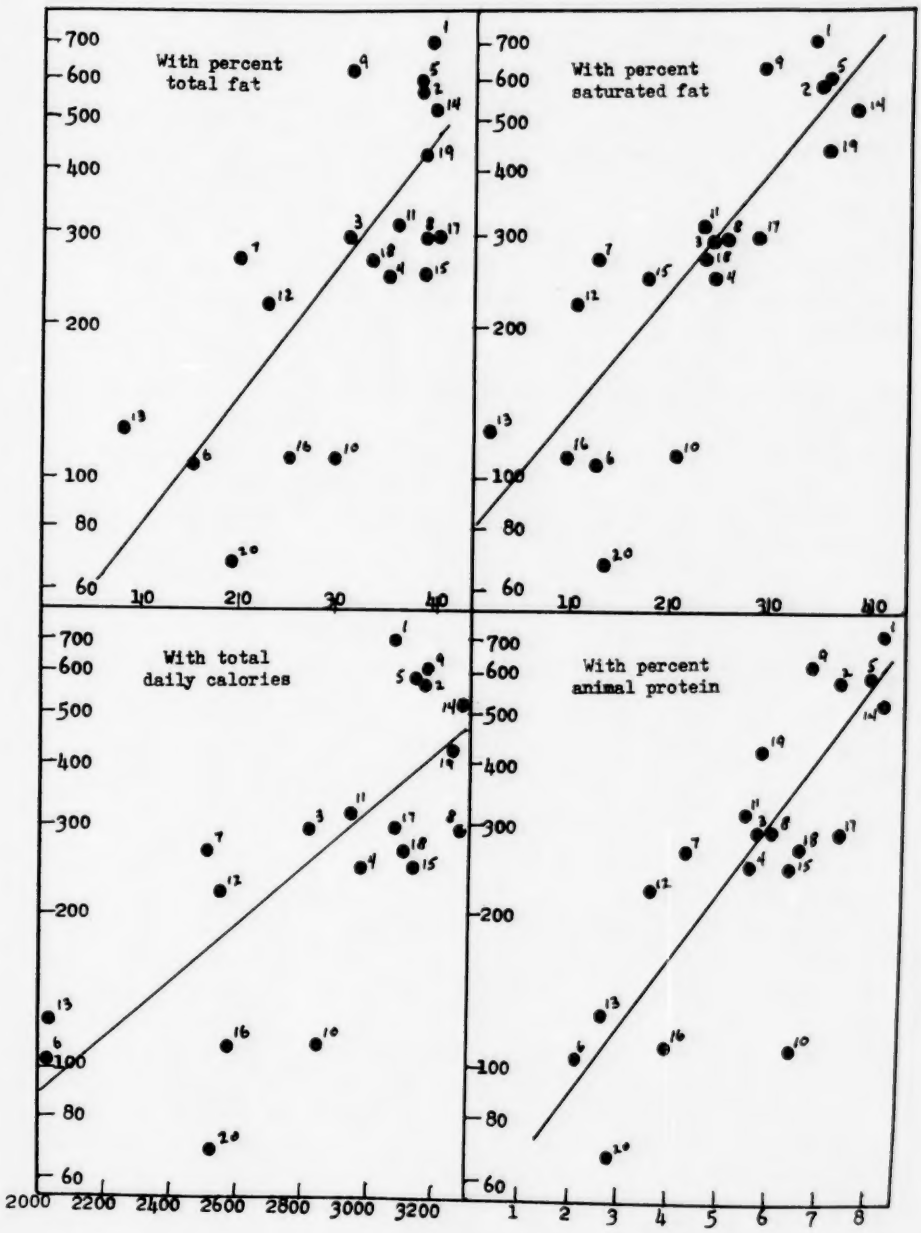

Fig. 2.—Association of B-26 death rates with the intakes of various dietary components. Semilogarithmic plot. (See Fig. 1 for key to countries.)

Would it be possible to explain still more of the variance by considering more than one factor at a time? How can more than one factor explain a major portion of the variance in the death rates?

The answer to the last question must be sought in the relationships shown in column C of Table III where it is shown that most of the supposedly independent variables are actually significantly intercorrelated with the intakes of saturated types of fat. This result might have been foreseen in the association of the intake of total fat with that of saturated-type fat since the latter constitutes such an important component of the former. Some of the others, though, are a little surprising and their implications will be discussed later. For the present, they serve to account for the overlap in explained variance in death rates among the several countries.

The answers to the first two questions raised may be determined through the use of multiple correlations. The high correlations of many factors shown in columns A and C of Table III make it evident that the effect of some of these factors on the death rate is a result not only of their own direct action but also of an indirect action attributable to their high correlation with one of the other not-so-independent variables. Where such a sizeable number of factors individually explain a large percentage of the variance in the death rate, it may be reasoned that consideration of more than one factor at a time would explain still more of this variance. Surprisingly, investigation of this possibility by use of multiple correlation techniques reveals that very little more of the variance is accounted for by considering more than one factor at a time than that explained by saturated-type fats or animal protein alone.

For example, the correlation of total fat intake *and* saturated-type fat intake with death rates is 0.8261, statistically identical with the 0.8259 obtained by considering saturated-types of fat alone. Similarly, the other multiple correlation coefficients shown in column D of Table III show little better relationship. It is apparent that the added consideration of a second variable has done little to aid the first in explaining the death rate variance. Moreover, consideration of more than two independent variables at a time is inadvisable for fear of serious loss of reliability attendant upon the fact that data for only 20 countries are available.

Although consideration of a second variable does little to aid the first in explaining death rate variance, we do not as yet know which of the pair under examination is the more important from this aspect. The relative importance of each member of the pair may be measured by the use of their beta coefficients (Table IV, column A). These beta coefficients transform the different independent variables to comparable terms and thus allow a direct comparison of the relative effects of each on the regression line. Therefore, the ratio of these beta coefficients (Table IV, column B) indicates the relative contribution of each factor to the coefficient of multiple correlation.

These statistical measures indicate that the intake of the saturated types of fat is of greater consequence than any other factor considered. The next most important association appears to be with animal protein, and, even in this case, the saturated fats are 1.6 times more important. The outstanding weight

TABLE IV. BETA COEFFICIENTS AND THEIR RATIOS OF B-26 DEATH RATES WITH VARIOUS FACTORS*

BETA COEFFICIENTS (A)	RATIO OF BETA COEFFICIENTS (B)	BETA COEFFICIENTS (A)	RATIO OF BETA COEFFICIENTS (B)
$\beta_{14.2}$ 0.9284	$\frac{\beta_{14.2}}{\beta_{12.4}} = 6.7$	$\beta_{14.6}$ 0.5338	$\frac{\beta_{14.6}}{\beta_{16.4}} = 1.6$
$\beta_{12.4}$ 0.1390		$\beta_{16.4}$ 0.3315	
$\beta_{14.3}$ 0.7999	$\frac{\beta_{14.3}}{\beta_{13.4}} = 24.8$	$\beta_{14.7}$ 0.8349	$\frac{\beta_{14.7}}{\beta_{17.4}} = 34.1$
$\beta_{13.4}$ 0.0322		$\beta_{17.4}$ 0.0245	
$\beta_{14.5}$ 0.8325	$\frac{\beta_{14.5}}{\beta_{15.4}} = 51.1$	$\beta_{14.8}$ 0.7034	$\frac{\beta_{14.8}}{\beta_{18.4}} = 4.3$
$\beta_{15.4}$ 0.0163		$\beta_{18.4}$ 0.1637	

*Subscripts refer to various factors as follows:
1 Death rate per 100,000 men, aged 55 to 59 years, 20 countries (ISC B-26).
2 Total daily calorie intake.
3 Total fat intake as percentage of total calories.
4 Saturated types of fat intake as percentage of total calories.
5 Unsaturated types of fat intake as percentage of total calories.
6 Animal protein intake as percentage of total calories.
7 General death rate per 100,000 men, aged 55 to 59 years.
8 Telephones per 100 population.

of these two latter factors invites some attention to the relationship between them. From column C, Table III, the correlations of saturated fat and animal protein (r_{46}) equal to 0.8751 indicates an intimate association. This may be explained by the fact that land mammal meats are carriers of fat, by the close affinity between the intakes of milk proteins and butterfat, and by the effects of close association between the intakes of fish proteins and marine oils.

Of the remaining five independent variables considered, only two others were investigated from the viewpoint of the direct effect of diet on the B-26 death rate. These were the intakes of total fat and polyunsaturated types of fat. The three others were judged as possible measures of other factors which might have an effect upon the death rate: (1) total calorie intake as a measure of the economic level of a country, (2) general age-specific death rate as a measure of the over-all health of a country with a possible reflection of the level of medical sophistication, and (3) number of telephones per 100 population as a possible measure of the stress and strain usually attributed to western-type civilization.

We may now investigate the other first order correlations between the independent variables. The high correlations between the proportion of total fat in the diet with the proportional intake of the saturated types of fat (r_{43}) and with total daily calorie intake ($r_{23} = 0.8975$, not shown in Table III) suggest the following picture. As the calorie intake of a country increases, the increase consists mostly of fat and, in particular, of the saturated type fat component.*

*It is also true that the proportional intake of animal protein increases ($r_{26} = 0.8827$). However, since the base is so much smaller, the absolute increase is relatively small and the major portion of the total calorie increase consists of fat.

This is further supported by consideration of the negative sign associated with r_{45}, confirming that saturated-type fat intake tends to increase at the expense of the intake of the polyunsaturated types.

The large number of proponents of stress and strain as an important cause of coronary heart disease makes the association of death rates and number of telephones per 100 population (r_{18}) of particular interest. Although this value (0.6901) is not as high as some of the dietary factors considered (saturated-type fat, 0.8259; animal protein, 0.8016; total fat, 0.7321), it is sufficiently so to merit further investigation. Turning to r_{48}, we note a definite association between the proportion of saturated types of fat in the diet and the number of telephones per 100 population (0.7483). To the extent that the proportional number of telephones is an adequate measure of stress and strain, there appears to be a real relationship with both heart disease rates and saturated fat intakes. It may be going somewhat far afield from the present subject, but it is difficult to refrain from speculating that many of the effects of stress and strain (if there actually be such) result from an increased consumption of saturated fats. It may well be that the basic security offered by food intake (when available) is used by many individuals to neutralize the effects of a period of stress. Inasmuch as the increased consumption of saturated fats with increased calorie intake has already been developed, this mechanism may explain in part the relationship of stress and strain with the B-26 death rate.

VOL. 9 1959

Death rates for category B-26 have been used for the analysis thus far. However, as noted previously (first footnote, p. 638), this category is mixed with respect to the thesis that dietary factors influence the coronary heart disease rate. Although it is true that category 420, our primary concern, is usually by far the major component of B-26, the adulterating influence of categories 421 and 422 must introduce disruptive elements which cannot be explained by the theory and therefore serve to increase the amount of unexplained variance. For example, in the case of Chile, it is known that a significant proportion of the B-26 death rates is a result of cardiac trypanosomiasis,[16] a consideration which cannot be explained by dietary factors and would therefore lower the foregoing statistical associations. If possible, it is therefore preferable to use the pure 420 death rates rather than those for category B-26.

That this has not been done for the foregoing analysis is a reflection of the fact that 420 death rates are available for only 14 of the 20 countries previously considered and, accordingly, conclusions based on the analysis of these data should be made even more cautiously. On the other hand, a counterbalancing consideration exists with respect to the reliability of the results obtained by using the data for only 14 countries. This stems from the fact that this latter analysis concerns itself with a more refined classification of data. It is very likely that the mere availability of data for a more refined category is a good indicator concerning the reliability of the data-gathering mechanism which produced it. This consideration may more than make up for the loss of reliability attendant upon the smaller number of cases and thus make this latter analysis more meaningful.

Comparison of the first order correlation coefficients for the factors found to be most important in explaining the variance in the B-26 death rates indicates that these 14 countries are representative of the twenty.*

TABLE V. CORRELATION COEFFICIENTS OF DEATH RATES FOR ISC 420 AND ALL HEART DISEASE* WITH PERCENTAGE INTAKE OF SATURATED TYPES OF FAT AND ANIMAL PROTEIN

COEFFICIENT OF CORRELATION† (A)	COEFFICIENT OF DETERMINATION† (B)
$r_{1_a 4}$ 0.9136	$r^2_{1_a 4}$ 0.8347
$r_{1_a 6}$ 0.8333	$r^2_{1_a 6}$ 0.6944
$r_{1_b 4}$ 0.5694	$r^2_{1_b 4}$ 0.3242
$r_{1_a 6}$ 0.6752	$r^2_{1_b 6}$ 0.4559

Critical values of r_{1_a} : α =	0.05	0.01
r_{1_b} :	0.532	0.661
	0.444	0.561

*Combined categories: B-22, vascular lesions affecting central nervous system; B-25, chronic rheumatic heart disease; B-26, arteriosclerotic and degenerative heart disease; B-27, other diseases of the heart; B-28, hypertension with mention of heart disease.

†Subscripts refer to following factors:

1_a Death rate per 100,000 men, aged 55 to 59 years in 14 countries (ISC 420).
1_b Death rate per 100,000 men, aged 55 to 59 years in 20 countries (all heart disease*).
4 Saturated types of fat intake as percentage of total calories.
6 Animal protein intake as percentage of total calories.

When the saturated fat intakes of the 14 countries are now correlated with category 420 death rates instead of those for B-26 (Table V), we discover that 83 per cent of the variance in death rates can now be explained instead of the former 68 per cent. Admittedly, sampling error for a sample of 14 can easily lead to somewhat lower values. Nevertheless, this consideration cannot detract sufficiently from a correlation of 0.9136 for death rates for 14 countries and percentage of saturated fat intake ($r_{1_a 4}$) to argue against the contention that the intake of saturated types of fat plays a significant part in explaining coronary heart disease in man.

*The coefficient of correlation between B-26 death rates and saturated fat intake (r_{14}) for the 20 countries is 0.8259. If only the 14 countries for which category 420 death rates are available are considered for this correlation, we obtain the comparable value of r_{14} equal to 0.8304.

Similarly, r_{46} (saturated fat intake versus animal protein intake) equals 0.8751 for the 20 countries and 0.8858 for the fourteen. The two values obtained for r_{16} (B-26 death rates and animal protein intake) do not compare as well (0.8016 versus 0.6704) but are still well within each others' range of sampling error and therefore are not significantly different.

Therefore, to the extent indicated by the foregoing correlations of the factors discovered to be most important in explaining the variance in the B-26 death rates, the 14 countries are representative of all 20.

To a great extent the increased association noted is a result of the refinement in classification. The elimination of categories 421 and 422 has removed causes of death which the quality-of-fat hypothesis makes no attempt to explain (e.g., chronic endocarditis; cardiac trypanosomiasis in Chile). Although such refinement is obviously correct technique, a step in the other direction (the further combination of categories) may also serve a useful purpose. Such combination may be used to answer the criticism that category 420 or B-26 death rates between countries are not comparable because of fundamental differences in diagnostic fashion or classification procedures. For example, it is held that in Japan, despite the work of Kimura,[17] the relatively small number of deaths in categories 420 and B-26 are offset by the large number of cerebrovascular lesions and thus the Japanese experience is, in reality, more comparable to that of the United States and other western nations.

Column C of Table I presents the death rates for men aged 55 to 59 years for the combined categories B-22, B-25, B-26, B-27, and B-28. They are: B-22, vascular lesions affecting the central nervous system; B-25, chronic rheumatic heart disease; B-26, arteriosclerotic and degenerative heart disease; B-27, other diseases of the heart; and B-28, hypertension with mention of heart disease.

Such a combination of categories would almost certainly include the pertinent cases irrespective of the classification procedures of a given country. It would be expected that such a mixture would not show as high an association with the dietary factors as was obtained with categories B-26 or 420 alone. When the correlation coefficients are determined, this is found to be true—they are lower although still highly significant (Table V, $r_{1_{b^4}}$ and $r_{1_{b^6}}$). Thus, even if there were differences in diagnostic and classification procedures between nations, significant correlations between dietary factors and all cardiovascular disease still exist.

DISCUSSION

There are some who contend that the increase in mortality from coronary heart disease since the 1920's is, for the most part, more apparent than real.[18] The argument here is that mortality rates among countries and, in the same country, from one time period to another are diversely affected by so many factors that there is little hope for real comparability. Some of these factors are:

1. Radical changes in procedures and classification used for recording causes of death (as of 1949).
2. Increasing age of the population.
3. Varying degrees of medical sophistication which include:
   a. Variation in the general level of medical training and experience.
   b. Broadening of the concept of coronary heart disease.
   c. Better diagnostic methods.
   d. Increasing fashion of this diagnosis.

Conceding that these factors actually affect the several nations differently, it is still quite difficult to ignore differences in mortality as shown in Table I

VOL. 9 1959

which reach the order of 10 to 1. And even if a difference of this magnitude were shown to be spurious, the lines of investigation being pursued would still remain valid, for the major problem is not whether the mortality rate from coronary heart disease has increased significantly from some base period (which may or may not have been adequately measured) but why it is at its present high levels.

Most will probably agree that the level of deaths from coronary heart disease is inordinately high, at least for the countries which consider themselves part of the highly industrialized Western culture. In the United States, where this mortality is highest, coronary heart disease is the leading killer of men at all ages 30 and over and, even in the twenties, this cause is second only to deaths from automobile accidents. Certainly, then, coronary heart disease merits investigation without considering the complicating feature as to whether or not there has been a real increase over the years.

There can be little doubt that real differences exist in coronary heart disease mortality among nations. In comparing the United States and Japan, it may suffice for a while to point to the high number of Japanese deaths attributed to cerebrovascular accidents and claim that differences in diagnostic and classification procedures in that country would serve to equalize its coronary heart disease rate with that of the United States. Such argument is rebutted by autopsy studies made in Japan[17] which confirm the infrequency of the clinical picture of coronary heart disease as observed by local physicians and coroners, i.e., infrequency of myocardial infarction. Ad hoc surveys in Japan as well as in other countries[19-26] have lent additional support to the rough accuracy of the vital statistics.

Thus some environmental factor or combination of factors must be sought to account for the differences in coronary heart disease death rates among countries, and the analyses set forth in the foregoing point to two dietary components, saturated types of fat and animal protein, as agents important enough to merit further consideration.

Although some of the papers discussed have rightfully called attention to the high association between intake of animal protein and the incidence of coronary heart disease, attempts to use the data to negate the influence of fat and differences in fat quality are spurious. Rather, they should be used to indicate leads for further study by laboratory and/or clinical methods. They cannot, in themselves, prove conclusively the correctness of a theorem although they may disprove one, since a satisfactory theorem must account for major epidemiologic findings.

The authors of the various previous papers discussed overlooked the next step in the analysis of the data indicated by the work of Bronte-Stewart, Kinsell, and Sinclair—the association with the saturated type of fat. Epidemiologic association without the feasibility of corroboration by other methods means little in itself. For example, the highest associations of all found by Yudkin[5] were with registered radio and television sets. Yet nobody seriously proposes a program of therapy or prevention which is based upon ownership of these conveniences! This association merely corroborates one of the findings of the

present study—the intercorrelations of the supposedly independent variables and their concomitant indirect actions.

Therefore, if laboratory and clinical methods cannot support the epidemiologic association, the conclusion must be drawn that the association is the result of the indirect action of factors which have not yet been taken into account. With respect to the intake of animal protein, Keys[27] found that the blood lipid levels were not affected by variations in protein intake ranging from 11 to 20 per cent of total calories where calories and fat quality and quantity remained constant. Olsen[28] obtained a fall in blood cholesterol by reducing protein intake to 25 grams per day, but this is well within the range of protein deficiency and cannot be considered for practical human diets. On the other hand, several investigators have been able to lower blood cholesterol levels and maintain them at a reduced level in a small number of subjects on low saturated-fat diets for a period of 6 months with no observable deleterious side effects.[29-31]

VOL. 9 195

SUMMARY AND CONCLUSIONS

International food and mortality statistics gathered by two United Nations agencies were analyzed to determine whether any significant association exists between dietary factors and coronary heart disease death rates as reported in several categories of varying refinement. As distinguished from several previous papers treating the same data, two new features have been considered here, (1) distinguishing between saturated and polyunsaturated fats and (2) treating independent variables in pairs rather than alone. In addition, several nondietary factors were considered in order to measure their effect.

Of all the factors considered, the intake of saturated types of fat was most important in accounting for the differences in coronary heart disease death rates between countries. Of somewhat lesser importance, the intake of animal protein also accounted for a large proportion of the explained variance in these death rates.

In the light of the foregoing which indicates that the intake of saturated fats is about 1.6 times as important as the intake of animal protein in explaining the variance in the B-26 death rates, it may be regarded that the epidemiologic data considered here represents no obstacle to the quality-of-fat thesis based on the work of Bronte-Stewart, Kinsell, Sinclair, and others. This theory indicts the intake of saturated fat as one of the principal epidemiologic associations with coronary heart disease and is a possible explanation why certain countries (Norway, Sweden, and Denmark) with high total fat intakes also exhibit relatively low coronary heart disease death rates. To the extent that epidemiologic data should provide rough agreement with hypotheses before these latter merit further consideration, these data do not negate but even offer some positive support for this thesis.

The other factors considered could not aid saturated fats or animal protein in explaining any additional variance in the death rates. However, they did serve to emphasize the bewildering complexity of associations and intercorrelations between factors which might ordinarily be thought independent, e.g.,

the proportion of telephones in a population and the dietary intake of saturated fat. It appears as though these factors and a host of others are almost inextricably bound into a unified structure which may be considered as the mode of Western civilized culture.

This latter observation remains as a caution to the investigator in this field that he can never be entirely sure whether his explained variance is a direct result of the factors included in his analysis or the indirect effect of factors as yet unknown, unconsidered, and immeasurable.

REFERENCES

1. World Health Organization, United Nations: Annual Epidemiologic and Vital Statistics, 1955. ————: Epidem. Vit. Stat. Report. 9: No. 10, 1956.
2. Food and Agriculture Organization, United Nations: Food Balance Sheets, Second Issue, 1955.
3. Keys, A.: Atherosclerosis, a Problem in Newer Public Health, J. Mt. Sinai Hosp. **20**:118, 1953.
4. National Dairy Council: National Food Supplies and Vital Statistics, Dairy Council Digests **28**:1, 1956.
5. Yudkin, J.: Diet and Coronary Thrombosis; Hypothesis and Fact, Lancet **2**:155, 1957.
6. Yerushalmy, J., and Hilleboe, H. E.: Fat in the Diet and Mortality From Heart Disease, New York J. Med. **57**:2343, 1957.
7. Mann, G. V.: The Epidemiology of Coronary Heart Disease, Am. J. Med. **23**:463, 1957.
8. Bronte-Stewart, B., Antonis, A., Eales, L., and Brock, J. F.: Effects of Feeding Different Fats on Serum Cholesterol Level, Lancet **270**:521, 1956.
9. Bronte-Stewart, B.: Effect of Dietary Fats on the Blood Lipids and Their Relation to Ischaemic Heart Disease, Brit. M. Bull. **14**:243, 1958.
10. Kinsell, L. W., Michaels, G. D., Friskey, R. W., and Splitter, S.: Essential Fatty Acids, Lipid Metabolism and Atherosclerosis, Lancet **1**:334, 1958.
11. Sinclair, H. M.: Deficiency of Essential Fatty Acids and Atherosclerosis, Lancet **1**:381, 1956.
12. Communication: Israeli Consulate.
13. Hilditch, T. S.: The Chemical Composition of Natural Fats, New York, 1956, John Wiley & Sons.
14. Keys, A., Anderson, J., and Grande, F.: Prediction of Serum-Cholesterol Responses of Man to Changes in Fats in the Diet, Lancet **2**:959, 1957.
15. Keys, A., Anderson, J., and Grande, F. : Effect on Serum Cholesterol in Man of Mono-ene Fatty Acid (Oleic Acid) in the Diet, Proc. Soc. Exper. Biol. & Med. **98**:387, 1958.
16. Biorck, G.: Environment and Disorders of the Circulatory System. Bull. New York Acad. Med. **35**:3, 1959.
17. Kimura, N.: Analysis of 10,000 Post-mortem Examinations in Japan, Vol. I, Cardiovascular Epidemiology, ed. by A. Keys and P. D. White, New York, 1956, Paul B. Hoeber, Inc.
18. Lew, E. A.: Some Implications of Mortality Statistics Relating to Coronary Artery Disease, J. CHRON. DIS. **6**:192, 1957.
19. Keys, A., Vivanco, F., Rodriquez-Minon, J. L., Keys M. H., and Castro-Mendoza, H.: Studies on the Diet, Body Fatness and Serum Cholesterol in Madrid, Spain, Metabolism **3**:195, 1954.
20. Keys, A.: Field Studies in Italy, 1954, Vol. I, Cardiovascular Epidemiology, ed. by A. Keys and P. D. White, New York, 1956, Paul B. Hoeber, Inc.
21. Bronte-Stewart, B., Keys, A., and Brock, J. F.: Serum Cholesterol, the Diet and the Relationship to the Incidence of Coronary Heart Disease, Lancet **2**:1103, 1955.
22. Mann, G. C., Nicol, B. M., and Stare, F. J.: The Beta Lipoprotein and Cholesterol Concentrations in Sera of Nigerians, Brit. M. J. **2**:1008, 1955.
23. Schindel, M.: Changes of Serum Total Lipids, Total Cholesterol and Lipidphosphorus in Jewish Yemenite Immigrants After Twenty Years in Israel. Cited in Keys, A.: J. CHRON. DIS. **4**:364, 1956.
24. Higginson, J., and Pepler, W. J.: Fat Intake, Serum Cholesterol Concentration and Atherosclerosis in the South African Bantu. Part II. Atherosclerosis and Coronary Artery Disease, J. Clin. Invest. **33**:1366, 1954.
25. Kusakawa, A.: Some Statistical Findings of Incidence of Coronary Heart Disease in Japan. In World Trends in Cardiology. Vol. I. Cardiovascular Epidemiology, New York, 1956, Paul B. Hoeber, Inc.
26. Voegelpoel, L., and Shrire, V.: Myocardial Infarction; Its Racial Incidence in Cape Town, Lancet **2**:1108, 1955.
27. Keys, A.: Diet and the Epidemiology of Coronary Heart Disease, J.A.M.A. **164**:1912, 1957.

28. Olsen, R. E., Vester, J. W., Gursey, D., Davis, N., and Longman, D.: Effect of Low Protein Diets Upon Serum Cholesterol in Man, Am. J. Clin. Nutr. **6**:310, 1958.
29. Gordon, H., Lewis, B., Eales, L., and Brock, J. F.: Dietary Fat and Cholesterol Metabolism, Lancet **2**:1299, 1957.
30. Brown, H. B., and Page, I. H.: Lowering Blood Lipid Levels by Changing Food Patterns, J.A.M.A. **168**:1989, 1958.
31. Jolliffe, N., Rinzler, S., and Archer, M.: Effect of a Prudent Diet on the Serum Cholesterol of Normal Weight Men Aged 50-59: A 6-Months Observation, Proc. Soc. Exper. Biol. & Med. **18**:531, 1959.
32. American Telephone & Telegraph Co.: The World's Telephones, 1957.

VOL
9
195

ADJUSTMENT TO DISABILITY

Some Observations on Patients With Multiple Sclerosis

PAUL CHODOFF, M.D.
WASHINGTON, D. C.

From the Department of Neurology, George Washington University Medical School

(Received for publication Feb. 10, 1959)

FACTORS INFLUENCING INDIVIDUAL ADJUSTMENT TO CHRONIC DISEASE

IN SPITE of an increased interest in the problems of the disabled since World War II and the appearance of a number of perceptive and valuable reports, it is clear that we are very far from possessing a comprehensive and inclusive theory of the whys and hows of individual adjustment to disability. Barker,[1] who reviewed most of the literature on the subject up to 1953, lists 20 conditions and mechanisms that have been proposed to account for the psychological effects of physical disabilities, and a survey of these makes it apparent that they afford little basis for a useful consensus. The absence of a theory whose validity has been tested and found to be reasonably reliable imposes a considerable disadvantage on practical efforts to help the disabled, leaving the field open for prejudices, impressions, and a priori assumptions which may be of doubtful value. For instance, it is a commonly held principle that tendencies toward dependency should be discouraged in the handicapped. There is room for doubt as to whether this is always and invariably a useful practice; it may be that in some cases efforts to combat dependency produce more comfort in his attendants than in the crippled person himself.

In contrast to the lack of clarity and the absence of agreement about many issues in the field of adjustment to disability, it is universally accepted that the patterns of adaptation which are seen do not depend solely on the type and severity of the handicap. Two individuals with the same illness and with very similar degrees of impairment of function may react very differently, just as some very severely afflicted people are able to be much more effective than others with only slight disability. The case of Helen Keller may be thought of in con-

Work aided by a grant from the Federal Office of Vocational Rehabilitation.

trast to particular individuals in any doctor's practice. In every case, between the disability and the adjustment pattern, there is an intervening variable, a set of circumstances through which the physical condition of the individual influences his behavior. It is the task of research in this field to define and analyze the factors entering into this intervening variable with the hope that ultimately a theory will emerge which will allow us to deal with the manifold emotional problems of chronically ill people with some hope of being helpful rather than merely busy.

This report is concerned with an effort to understand the kinds of patterns of adjustment manifested by a group of patients more or less disabled by multiple sclerosis, to analyze the structure of these patterns and their function in the lives of the patients, and to study some of the interactions between disabled people and those in the normal population with whom they come into contact. No attempt has been made to go into the reasons why a particular pattern was chosen by the individual who manifested it; we are concerned here with the "how" rather than with the "why" of adjustment, with its current dimensions rather than with its history. It seems probable, however, that the choice of processes for dealing with the problems imposed by a disability would not differ materially from personality development in general, that is, such processes would be the resultant of life experiences and constitutional endowment.

All the patients included in the study had multiple sclerosis, diagnosed on the basis of unequivocal criteria at the Multiple Sclerosis Center at the George Washington University Hospital. The chief method of investigation used in this project was group psychotherapy, 17 sessions, each lasting for 1½ hours, at weekly intervals, over a period of 3½ months. There were two group leaders, myself and another psychiatrist, and there was, in addition, a nonparticipating observer. After each session, the two leaders and the observer met for a period of discussion of what had happened at the meeting, and each of the two psychiatrists later dictated or wrote up a report on his own observations. Each session was recorded on tape and was later transcribed so that everything that was said during each meeting was available for later perusal. After the completion of the group therapy phase of the project, each patient who participated to any extent was interviewed individually by one of the psychiatrists. Certain formal psychological tests were performed on all patients and special neurologic procedures were used in a few cases where they seemed appropriate. It should be noted, however, that the observations reported in this paper are derived almost entirely from the group therapy phase of the study.

A total of 21 patients participated in the project. The attendance at the group meetings varied from 4 to 19 with an average attendance per session of 9 patients. The number of sessions attended by individual patients ranged from 1 to 17 with an average of 9 sessions per patient. Eighteen of the patients were white and 3 Negro; 10 were men and 11 were women. Sixteen were employed either full or part time in various occupations or as housewives, while 5 were not functioning gainfully. There was a considerable range of experience represented in the group as far as types of background, education, income, intelligence, occupation, and sophistication are concerned. The range of neurologic disabilities

was a wide one extending from 2 ambulatory patients in very good remission to 5 patients confined to wheel chairs, with many intermediate degrees of difficulty. Visual and speech difficulties, ataxia, weakness of one or more limbs, spasticity, paresthesias and numbness, and sphincter disturbances were all present in the group in varying grades of severity.

From the previous description it can be seen that the patients studied appear to form a fairly diverse group with regard to a number of socioeconomic criteria and that they are also quite representative of grades and varieties of disability due to multiple sclerosis except for the absence of individuals so severely handicapped as to be bedridden. This does not mean, however, that no selection factors were involved in the formation and final composition of the group. In the first place, disability for any other reason than multiple sclerosis was excluded and thus the patients studied do not represent anything like a random sample of the disabled from all causes. Multiple sclerosis patients were selected for reasons of convenience and availability with the incidental thought that a common focus of interest would make it easier for them to develop group identity. It is recognized that the special character of multiple sclerosis with its remission and exacerbations and the consequent uncertainty of the patient's future introduces some conditions not seen in other causes of similar disabilities, but in spite of this it seems to be a reasonable assumption that conclusions drawn from a study of such a group will be applicable not only to patients with multiple sclerosis but also to other adults with acquired and either stationary or slowly progressive disabilities of the kind seen among our patients. Thus an adult with a traumatic paraplegia or even one with crippling rheumatoid arthritis must come to terms with his environment in the face of problems very similar to those faced by the multiple sclerosis patients.

Also, since all of the patients had been referred to and had gone through the diagnostic and evaluative procedures of the George Washington University Multiple Sclerosis Center, it may be said that they have special characteristics in their active seeking for help. This does not seem to be a characteristic, however, which sharply differentiates the patients studied from others with chronic diseases without a known cause or effective treatment since many of the victims of such afflictions are motivated more or less actively to seek help wherever they think they may find it.

The most important factor bringing about a certain degree of selectivity in the patients who remained in the group and attended most of the sessions was the fact that certain members dropped out after coming to the first meeting. Most of those remaining in the group were individuals who, in our culture, would be considered to be well adjusted to their disease while some of those who did not continue would be considered poorly adjusted.

THE SITUATION OF THE DISABLED

In order to understand the patterns of adjustment which the individual with multiple sclerosis, or with a chronic disability from any other cause, must employ to deal with the changed world in which he finds himself, it is first neces-

sary to acquire some understanding of how he perceives that world. In other words, what is the situation of the patient with multiple sclerosis? Under what conditions does he live and have his being? I am speaking of the individual on whom the diagnosis has been made, who has been informed of it, and who has some understanding, even though superficial, of what this means. If his symptoms are disabling, he finds himself unable to perform all kinds of activities which previously would have been almost automatic; to get out of bed and dress himself may require an amount of planning equivalent to that entering into the preparation for a battle, while going to the store may demand the foresight necessary for a whole campaign.

Consider the grotesque dilemma of a 53-year-old woman badly disabled with multiple sclerosis, who fell out of bed early one morning and found herself lying on her stomach on the floor, unable to pull herself up, with no recourse except to call for help. This she did but was unable to arouse anyone for half an hour. What are the emotional processes which allowed her to welcome, with apparent equanimity and without obvious anger or despair, the rescuers who finally came to her assistance, and to what extent did her utter dependence on them bring about this reaction? Even if the degree of impairment of function is much less obvious than in the case of this patient, the problems of adjustment which present themselves, although not as dramatic, may be even more poignant. Another patient, who is ambulatory and whose weakness and ataxia are not as apparent unless she becomes fatigued, ventured on a shopping trip with a fellow employee who did not know she had multiple sclerosis. The expedition proved to be more than the patient could tolerate. The streets she had to cross seemed to become wider and wider and the cars more terrifying. Her balance became impaired and she found herself bumping into her companion. She was unable to explain her condition and thus secure the rest she needed because she felt that her security at her job depended on her ability to present herself as in good health. Like the first patient, this woman did the best she could, hobbled along, proffered lame explanations, and made her adjustments to the feelings which welled up in her.

Even if the patient is fortunate enough to be in a symptom-free remission, he is not, and cannot be, what he was before he became ill. He never again can operate with his previous degree of independence, for it is always possible that another attack may come along and again render him crippled and dependent. In all of these situations—marked, obvious crippling, subtle impairment of function, or symptom-free uncertainty—the patient's relationships with those about him will be colored pervasively by his actual or potential helplessness. To an extent far in excess of what occurs in physically well people of reasonably good emotional health, the disabled and crippled carry with them, as a perpetual shadow, whatever they do and wherever they go, the necessity of dealing with the dependent needs mobilized in them by their actual or potential helplessness. This is of such paramount importance, coloring all of their dealings with human environment, that it seems likely that these varied and complicated reactions to this elemental problem of dependency are responsible for much of the behavior of the patient with multiple sclerosis and of the disabled in general.

VOL.
9
195

It was evident in the behavior of the patients in our study that the reaction to increased dependency is characterized by a good deal of ambivalence. Dependency is not only a threat but also may be a temptation. Thus the first patient referred to said, "Some people are good and lazy and set back in their chair and think 'Well heck, I don't have anything more to do.' Please God, I'll never get like that." The attitude that dependency is a threat which must be resisted is likely to be the conscious one, while the longing to be taken care of like an infant is seldom present for long in the individual's awareness. This is because few people can accept such a component of their personalities without guilt and the very vehemence with which such a wish is rejected may be a measure of its unconscious strength. Some of the emotion-laden and unrealistic rejections of a needed wheel chair undoubtedly stem from such a mechanism.

There is evidence also that this conflict between the conscious rejection of dependency and the unconscious longing for it is often accompanied by hostile impulses. Hostility is generated because to be dependent on another person implies that one is actually subservient and inferior to him, especially in our Western culture with its premium on striving and achievement. It may be that the rather frequent tendency of the patients in the group to snipe at their doctors, ostensibly for the failure of their medicines, is an example of this kind of hostility. Characteristically, in this example, the hostile feelings are not expressed directly but are attached to another rationalized cause. Instead of saying, "I hate you because I am dependent on you and am therefore your inferior," the patient says "You are no good, your medicines are ineffective." One reason why the hostile impulses are not often expressed or experienced directly is that to be angry at those who are taking care of us is to deprive ourselves of support which may be vital for the very necessities of life as in the case of the first patient described. Also, as has been pointed out by Long,[2] the disability of the patient with multiple sclerosis often affects the very motor pathways whereby aggressive impulses are transformed into action so that these impulses are blocked from expression even at this level. An example of this was reported by a third patient, who was awakened late at night by an inconsiderate phone call. When this had happened before he became ill, he would become furiously angry, get up, and take a long automobile drive. Now he could not drive, and, instead of becoming as angry as previously, he was aware more of a feeling of dull depression.

Thus for the reasons described in the previous paragraph, basic conflicts about the acceptance or rejection of the dependent impulses mobilized by the disease process and about the recognition and expression of the hostility which accompanies the dependent position are often not available to the conscious awareness of the disabled individual. Being unconscious, the conflicts cannot be dealt with directly and reasonably by the executive arm of the personality of the patient, but also, being dynamic and not static, they must be brought into some kind of equilibrium if the individual is to be able to function. It is the thesis of this paper that the adjustment of the disabled person to his disease can be understood largely in terms of the measures individually undertaken to deal with these nuclear conflicts.

The above statement should not be taken to mean that the kind and degree of disability from which the patient suffers is unimportant in determining the kind of adjustment he will make, but only that, except in cases of extreme crippling with which this report is not concerned, the effects of the disability in producing the adjustment pattern for the most part will not be direct but will operate through an intervening variable. This intervening variable may be taken to be the particular and unique personality of the individual as this has been formed through his life experiences in his culture. One might picture the disabled person as existing in a kind of triangular prison, the walls consisting of his personality, either flexible or rigid, his disability, mild or severe, and the culture in which he resides, either positive or negative in its attitudes toward physical handicap. Depending on the relative strength of these factors, the walls will be higher or lower with consequent lesser or greater freedom of action for the patient.

VOL. 9 195

THE PROBLEM OF "ADJUSTMENT"

The term "adjustment" has become so loaded with connotations that it is necessary to state that it is used here simply to designate those patterns of adaptation which constitute more or less characteristic modes of dealing with a disability. These patterns are essentially dynamic and should not be thought of as fixed or invariable. In the difficult business of getting along in the world with a physical handicap, more than one string to the bow is required. When this project was planned, it was believed that values could be attached to different patterns of adjustment, using as the two criteria by which an individual's adjustment could be assessed, first, his ability to be productive within the limits of his disability, and, second, his inner comfort. However, as time went on, it became apparent that those criteria were not at all easy to apply except in a very general way and that the task of giving good or bad marks to adjustment patterns requires the kind of omniscience which might be needed to assign degrees of happiness or virtue to those about us. Thus, whose adjustment is better, a patient who, though confined to a wheel chair, drives himself to work every day, often exhausting himself in the process, partly at least because of his need for the praise and admiration this brings him, or a patient, who exaggerates his less serious disability and does no work, but successfully forces those about him to care for him? In terms of his society there is no doubt that the former is better adjusted but in terms of the two individuals themselves, the problem is more subtle and the answer may be less obvious.

ADJUSTMENT PATTERNS

I will now proceed to a discussion of what has been observed of the patterns employed by individuals with multiple sclerosis in dealing with the largely unconscious conflicts over the dependency mobilized by their disease and the hostility accompanying this. These conflicts are, of course, more severe in some individuals than in others and vary in intensity from time to time in most. There are certainly occasions when disabled people are able to attain an objective, nonbitter, and insightful acceptance of their increased need to be dependent,

and who can then deal with the world about them in the manner which has been described by Tamara Dembo[3] as "acceptance of loss without personal devaluation." There is no reason to believe that among the disabled, the percentage of such persons who are able to adopt such an attitude habitually is any greater than the percentage of "perfectly normal" individuals among the general population, and, for practical purposes, most people with a physical handicap must deal with their problems in a less than ideal manner, just as the rest of us do with our problems.

Among the patients with multiple sclerosis studied in this project, two main patterns of dealing with the problems of dependency and hostility other than the method of insightful acceptance were observed. Although these are not mutually exclusive and both patterns are available to, and can be employed by, all patients on some occasions, it was found that there was a tendency for patients to fall into two groups, depending on which of the two patterns was more likely to be used. In the first of these patterns, conflicts over dependency and its attendant hostility are dissociated from awareness through the use of various personality defense mechanisms, particularly the defense of denial, but also including others such as reaction formation and projection. This adjustment pattern is primarily repressive and represents a way of fighting the conflicts brought on by the disability rather than accepting them or surrendering to them.

The second pattern of adjustment observed is, in a way, the opposite of the repressive, denying one. In this pattern, the individual does not deny he has an increased need to be taken care of, but rather he exaggerates his dependency and clamors for even more help than his physical state might actually require. This is a regressive rather than a defensive pattern and represents a way of giving in to the impulses rather than a way of fighting them.

THE DENIAL PATTERN

Many workers on the subject have emphasized the importance of the defense mechanism of denial in sufferers from organic disability, particularly that resulting from disease of the nervous system[4] as well as in such nonorganic conditions as manic states[5] and hysterical conversion reactions.[6] The term, however, is not always clearly defined, it is sometimes used in more than one sense, and it is sometimes confused with repression. In order to make clear how it is used in this paper, the following definition is offered. By denial is meant a defense mechanism in which some element of external reality, either a fact ("my leg is paralyzed"), or its significance ("this makes me dependent"), or the affect arising from it ("I am angry because of this"), is disclaimed in the interests of keeping from conscious awareness an impulse or conflictual impulses which the executive ego of the individual is unable to deal with directly. To a greater or lesser extent, all of the patients with multiple sclerosis studied made some use of denial, their heightened need for this defense being a consequence of the conflicts engendered by their disability. One should not be surprised at this since very few of us, even without the handicap of physical defect, would be able to maintain our psychic equilibrium, unless we denied the meaning of some of the fearsome facts

which face us every day or kept ourselves from feeling the anxiety they provoke. The existentialist point of view, currently of great interest, has as one of its primary tenets the stripping away of the almost universal veil of illusory denial of the meaning of the fact of death, whereas an integral part of most religions, and even perhaps their very reason for being, is the institutionalized reinforcement of the denial of mortality.

The ways in which denial may appear in the handicapped are quite varied. Most simply and crudely, there may be an explicit verbal disclaiming of the existence of the disability, such as "It is not true that my legs are paralyzed, therefore my fear (or wish) that you will have to take care of me like a baby is unnecessary and I do not have to worry about it." Such a direct form of denial, a variety of anosognosis, is actually a kind of delusion and was not seen in the patients in this study, all of whom were operating at a far from psychotic level.

However, as Weinstein[4] has pointed out, denial need not be explicit, but may be implicit, expressed indirectly in both verbal and nonverbal behavior. To an eye alerted to the nuances of its manifestations, evidence of denial was easy to discover in the pages of the transcribed recordings of the group sessions. In a sense, the almost compulsive energy with which many of the patients attempted to compete with the unhandicapped represents a very profound denial of the realities of their condition. Their attempts in this direction often went far beyond a reasonable effort to live up to but within their limitations, and could be understood as a method of keeping in check the ego-alien dissociated hostile and dependent impulses. Certain slogans, "you've got to keep going," "you're as good as anyone," "other people are worse off than you," "mind over matter," were repeated at almost every session with a kind of incantatory fervor which seemed to have for its purpose the denial and transformation of reality from what it was to what they wished it were. Not to be working, or at least making an effort to secure gainful employment, especially in the case of the men, was accepted by all as a shameful state of affairs, a judgment which did not have as much to do with the fact that it is necessary to work to support oneself as it did in reinforcing the prevailing fantasy that the patients could compete successfully with anyone and that their often very serious disabilities were, somehow, not important. That you were out of work not because you were so disabled as to be unable to get a job, but for some other reason such as your own shiftlessness, was an article of faith with most members of the group. The bulk of one session was occupied by a concerted and persistent attack by the majority of those present against a patient because they felt that he was not making a sufficiently earnest attempt to secure a hand-operated taxicab and a license to operate it. The patient gave various rather weak and unsatisfactory reasons for not following through on his plan, but these were brushed aside by the group (and particularly vigorously by several women members) in a firm, inquisitorial, and almost openly hostile manner, and it was made clear that if the patient was to maintain his good standing he had better get the cab and the license. The quite obvious reason why the patient was not driving such a vehicle was that he was probably the most badly disabled patient in the group, with paraplegia in both lower extremities, ataxia in both uppers, and defective vision. These

rude facts were virtually ignored during this discussion, both by the patient and by the other members of the group; the possibility that the patient might be too badly disabled to carry out his wishes was simply not in the group awareness. The whole sequence constituted a striking denial of an unpalatable aspect of reality.

As might be expected, the wheel chair served as a particularly important focus for the group's conflicts about dependency. What was most striking in the attitudes about it was how seldom it was dealt with simply as a mechanical device which might be useful in making life more comfortable. Far more often was it reacted to in terms of its symbolic value, as an indicator of the need to be cared for by others and of the inability to compete as an equal. No one in the group ever expressed openly a wish for wheel chair life as a refuge from the heat and strife of attempting to pit his defective physical equipment against the vigorous and the unhandicapped. Such feelings, if present, were unconscious and might be suspected only from the vigor of some of the negative expressions. It seemed to be good form to voice the most vigorous possible abhorrence for the wheel chair while at the same time expressing the belief that one could, somehow, by an effort of will, either avoid or reverse the need for using one. When one patient expressed openly her despair at being in a wheel chair, her outburst seemed to generate anxiety in a number of other patients who chided her for feeling hopeless, reiterated slogans about how she would be able to will herself to an ambulatory status again, and rather quickly changed the subject. On the other hand, another patient met with a rather uneasy and critical reaction, as if she were being tactless, when she forthrightly announced that she was preparing herself for the possibility that she might in the future require a wheel chair and that she hoped to be able to accept it then as a necessary convenience. Of course, some of the negative attitudes probably were based on a realistic recognition of the fact that the wheel chair patient is viewed very differently by healthy people and that he acquires a new and sometimes unpleasant set of interpersonal relationships.

An important set of devices employed by members of the group to deny some of the implications of their disabled conditions might be subsumed under the heading of magic. By this I mean the belief that some supernatural agency would intervene miraculously in their behalf or, at a less unsophisticated level, a rationalization of such a belief through the uncritical acceptance of pseudoscience and pseudomedicine. It might be argued that such beliefs are not illogical or unreasonable if considered in terms of the cultural and particularly the religious and educational backgrounds of some of the patients, rather than through the eyes of the more scientifically trained physician observers. However, the fact that a personality defense is ego-syntonic does not mean that it is not also serving a defensive function if there is evidence that this is what is happening, and, in the instances noted in the group, the rigidity of the operations I have designated as magical, their unmodifiability in the face of cogent contrary evidence, and the fact that definitive testing was avoided, all attest to their defensive nature. An interesting example of this mechanism, at a rather obvious and primitive level, was afforded by a patient who announced one day his firm

belief that an itinerant faith healer, Brother Mark, could cure him of multiple sclerosis. When asked why he had not taken advantage of the opportunity, he replied that Brother Mark required that he give up smoking in order to be cured and he just couldn't seem to do this. Here the patient was clinging to his fantasy of a magical cure, thus denying the realities of his condition and at the same time employing a transparent subterfuge to avoid putting his belief to the test which would destroy it and deprive him of his defense. This patient was not the only exponent of the magical cure in the group; this was a frequent topic of discussion. Every newspaper or magazine article on the subject was discussed eagerly and generally uncritically. Another patient informed the group that a participant in a television program on multiple sclerosis stated that when the cure was found, not only would the progress of the disease be halted, but all disabilities would disappear, and the victims would be restored to normal. This had not been said on the program but was a distortion manufactured by the patient out of his need to believe it. One of the patients who dropped out of the group at an early point later explained her action as stemming from her belief that a certain multiple sclerosis clinic on the West Coast was able to cure the disease, and she was afraid she might hear something critical of this clinic in the course of the group sessions.

Right from the beginning, there was much questioning as to the purpose of the group. In response to this, I stated on several occasions that the group was formed for the purpose of discussing experiences in living with multiple sclerosis, how the disease affected the lives of its victims, and how the problems it brought about might be dealt with more effectively. Also, more than once, in replying to questions, I made it clear that, medically speaking, the cause of multiple sclerosis was not known and there was no effective treatment for it as yet available. In spite of these clear and unequivocal statements, a number of the group members continued to adhere with adamantine persistency to the thesis that the purpose of the group was to find a cause and cure for multiple sclerosis. The most vocal, though by no means the only exponent of this point of view, was a patient who was also the votive priest of the doctrine of mind over matter, the belief that the effects of the disease could be conquered by an effort of will. Those who continued to hold the cause and cure theory of the purpose of the meetings expressed indignation at members who failed to attend, since the more members the more chance of our hitting on the answer. They also made the suggestion that other doctors attend the meeting for the same reason, although this may also have been motivated by overt disappointment with the physician leaders for having failed to reward them for their good, striving, compliant behavior by dispensing the magical cure. I felt that this hope, at an unconscious level, that they would be magically rewarded for their good behavior, was one of the principle motives behind the continued attendance at the group sessions of a number of the patients, and felt also that the need to adhere to this fantasy was strong enough to account for the inability to absorb my statements about the actual purpose of the meetings. The whole complicated operation can be thought of as a magical denial that multiple sclerosis is incurable, that it often results in increasing disability, and that dependence, inferiority, and hostility are the concomitants of that disability.

More subtle forms of denial, not as direct as some of those described and occurring in combination with other personality defenses, may be thought of as the psychodynamic explanation both for those patients who displayed guilty and depressive reactions to their illnesses and for those who tended to blame other people for their condition. The former group blamed themselves for having gotten sick, either because of some unknown defect in themselves or because they had overexerted themselves, tried to do too much, eaten improperly, or indulged in various excesses, while the latter reaction was often in the form of blame for doctors who had misdiagnosed or mistreated them or who were more interested in money than in the welfare of their patients. Both of these attitudes, whether blame is assigned inward or outward serve the purposes both of denying that the patient is helpless and impotent in the face of an impersonal and remorseless disease process and also of affirming the hope of magical relief, since if one is sick because of one's own misdeeds or someone else's malice, then there can be hope of cure through expiation or propitiation. This kind of blaming reaction was observed quite generally in the group and was not confined to those patients who made use primarily of the denial form of adjustment. Orbach and Bieber[7] give a very similar explanation of the depressive and paranoid reactions occurring in a group of nonpsychiatric patients subjected to dangerous and mutilating surgery for cancer. As they say, "What is denied (by such reactions) is the fact that such omnipotent control is impossible or that a state of helplessness exists in the face of a grave threat to survival."

OL.
9
959

THE REGRESSIVE PATTERN

As differentiated from the denial pattern described in the preceding section, there is another method by means of which disabled people can deal with the largely unconscious conflicts over dependency and its accompanying hostility which are aroused in them by their relative helplessness. In this method, instead of denying his dependent needs, the patient, in effect, proclaims his dependency which he justifies to himself and to others on the grounds of overwhelming handicap. He abdicates any claim to competitive equality with those about him and in return demands from them that they take care of him. It is in his interest to exaggerate rather than to minimize his physical disability as is done by those patients primarily employing the repressive pattern, and he is willing to endure the disapproval and contempt he often evokes for the sake of the gratification he receives.

It should be repeated, for emphasis, that no patient is wholly repressive or wholly regressive, all of them, in the words of Harry Stack Sullivan, being "simply more human than otherwise." However, behavior indicative of the denial mode of adjustment was seen with much greater frequency in the group of patients with multiple sclerosis who took part in the project. Those employing primarily the regressive mode either failed to come into the group or dropped out soon after it was organized. As might be expected, an individual who depends for his security on convincing himself and others that he is too sick to help himself would very soon be made anxious in an atmosphere echoing with hortatory

cries of "Don't let it get you down," "You've got to keep trying," and "Lots of others are worse off." Besides, not being blinded by the need to deny his dependent impulses, he may be in a position to observe that some of the above statements are patently false.

An example of this type of individual is a patient who had, all his life, displayed a pattern of evading responsibility and attempting to be cared for by others. The role now taken by multiple sclerosis as the scapegoat for his inability to support himself had been filled previously by anti-Semitism. Only moderately handicapped by the disease, he had quit several jobs obtained for him because he felt they were too much for him, and he now spent his time at home while his wife went out to work. In the opening session of the group, the only one he attended, in contrast to the initial statements of most of the others which emphasized their normality and their determination to keep trying, this patient made much of his suffering and incapacity and of how bad his situation was in contrast to well people. Incidentally, illustrative of the unconscious purpose of this approach, he elicited a good deal of sympathy, even from patients in much worse condition than he. In spite of invitations to do so, he failed to attend any more meetings on the ground that the effort required was, again, too much for him.

The opposing viewpoints toward dependency were illustrated in a dialogue between a female and a male patient about whether the former would give the latter a hypothetical $1,000 bill if she had it to give. The man indicated that he would certainly take the money and indicated he deserved it because of his illness and suffering while the woman was very disapproving of this attitude, especially if he were to use the money, as he said, to get drunk and have a good time. If, on the other hand, he used the money for the hand-operated cab, she might consider giving it to him a useful thing to do. On one occasion, another patient, usually a strong advocate of trying all the time and of mind over matter revealed, rather unexpectedly, that he sometimes used his illness as an excuse to get time off or to take it easy. In both of these examples it can be seen that patients who ordinarily utilized the denying, repressive mode of adjustment were able, also, on occasion, to shift to a type of operation in which helplessness and dependency were admitted and even exaggerated for the sake of immediate gratification. The ability to shift orientations was common though it could be observed more readily in the behavioral than in the verbal sphere, in which a kind of self-hypnotizing repetition of the denial slogans and attitudes seemed to provide security. Such elasticity may very well make for a useful adjustment to the disease, whereas the rigid and obligatory employment of only one or the other mode may interfere with the individual's ability to deal appropriately with reality.

To the extent that it is present and able to be utilized, insightful acceptance will diminish the need for either repression or regression, and examples of such an attitude were not infrequent. The previously described statement of the patient on how she was preparing herself for the possibility that she might someday require a wheel chair is such an example and it is matched by the way in which another patient one day very realistically and factually told how he was

VOL. 9 195

preparing himself for possible loss of sight. A statement by yet another patient might serve as a model for an attitude of reasonable acceptance of disability as one facet of life rather than as life's end: "Once in a while somebody'll say to me, 'I would think you'd go to bed every night praying for a cure for multiple sclerosis,' and I think to myself, 'I've got something better to do.' When a cure comes for multiple sclerosis, I'll be right there standing in line to get my dose. But I'm not nearly as concerned about the future, about getting well as I am about being cheerful and doing a good job. I think it's a waste of time to spend too much time just waiting for a cure. I mean I think that life is more worthwhile than to just be wishing it away." Certainly neither an entirely defensive or regressive attitude can account for the recognition discussed at one meeting that being disabled can produce a strengthening and deepening of one's relationship with one's children and that the effects of the disease are not all destructive since an increase in human sensitivity and in insight, patience, and understanding can result from it as well. Regardless of what adjustive devices they depend on, a great deal of very admirable courage and patience was evident in the behavior of many of the patients in the group.

DL.
9
959

TRANSACTIONS BETWEEN THE DISABLED PERSON AND HIS HUMAN ENVIRONMENT

Participation in the group sessions brought out very clearly the magnitude of the difficulties interfering with communication between the disabled and the healthy people with whom they come in contact. Instead of a meaningful exchange, what often occurs when a patient has some dealings with an individual who is not disabled is in the form of a stilted dialogue in which transfer of information is hampered by the fact that, on both sides, much of what is going on is either out of awareness and thus not expressed at all or expressed only indirectly, or is not at all understood. This is so, I believe, because the attitude of individuals of each group toward those of the other contains elements of ambivalence to start with, and this ambivalence is often increased rather than diminished in the transactional processes which occur between the two. An attitude on one side, even when itself unconscious, will induce a reaction on the other which is, in turn, reacted to, thus setting up a reverberating process which has the effect of clogging the communication channels with "noise" and distortions. I am aware that the foregoing, unfortunately, is a description of much of what goes on between people generally, but here we are concerned with the effect of the disability in interfering with the perceptions which are essential for effective communication.

In the case of the disabled person, the reasons for an ambivalent attitude toward those about him are not difficult to understand. Like the rest of humanity he possesses human needs for the liking and respect and sometimes for the help of other people. However, the effect of his disability is to bring about an intensification and distortion of these needs as they come into conflict with what he expects society to expect from him and as his performance falls more and more short of the requirements of his idealized self-image. Such a conflict often brings with it, as has been described previously, a certain measure of hostility, envy,

and fear toward the nondisabled. Even when in awareness, there is a limit to the extent to which such feelings can be expressed directly, because, among other reasons, patients are immediately or potentially dependent on those with whom they come into contact. In the patients whose main reliance is on the defensive, denying mode of adjustment, some of these negative feelings are given indirect expression as, for example, in the form of griping complaints about the lack of interest or greediness of doctors, or in the incident described with relish by a patient relating the discomfiture of an officious lady in a subway when she questioned an apparently healthy young man about why he was not in the military service and was confounded by his display of artificial limbs. However, much of the hostility in this group of patients is kept out of awareness through a reaction formation resulting in behavior designed to please and placate the well people about them. This appears to be the mechanism behind much of the almost compulsive insistence on how hard they are trying to do what they feel is expected of them, and to what lengths they will go to get along with everybody. Thus one patient said, "I try to get along with everyone and do things that they want to do. Sometimes I think that maybe they're not right but just agree with them to get along with them." It is obvious that this sort of behavior results in a good deal of secondary gain in the form of praise and commendation for such culturally approved activities, and the fact that it pays off in this way will, in itself, tend to increase repression of negative feelings. There were frequent examples of this in the way patients would describe with great complacency the praise they have received for their efforts at working and in the veritable orgy of self-congratulation which engulfed the group one session when they were favorably comparing their struggles to get to the meetings to the slothful laziness of those who had dropped out. (Incidentally, I could detect rather easily in myself a reflection of the group's hostile attitude toward those who had dropped out.) Such efforts to do what they feel is expected of them certainly may be regarded as a realistic attempt to make the best of a bad situation, but it is sometimes something more than this, as is indicated by a tendency of these patients to extract increasing amounts of credit by attempting to do more than they are really capable of doing. Occasionally, at such times, one could even hear expressions of resentment that so much is expected from them. In line with this observation is a recent experimental study by Jaffe and Slote[8] who were able to show that the attitude of the interviewer and the way his questions were phrased had a definite effect on the amount of denial expressed by a group of neurologic patients in response to a standardized questionnaire.

Those patients who regress to rather than deny their dependency do not show a reaction formation to their hostility, but are more likely to manifest it indirectly by complaining, whining, and by unreasonable and excessive demands which have the effect of making those around them feel not only annoyed and impatient but also guilty because of the nasty thoughts they are having about "sick invalids." Patients who display much of this sort of behavior cannot bask in the social approval bestowed on the defensive group and must get their satisfactions from direct fulfillment of dependent needs and from their ability to manipulate their environment. There is sometimes a psychopathic-like

VOL.
9
1959

quality in individuals who utilize such operations, as in the case of one patient, an early and relatively undisabled case of multiple sclerosis, who, during the group sessions, appeared to be wavering between the two orientations and had not fixed firmly on either one by the time the project was finished. When I saw him sometime later, he reported, with a mixture of relish and apology, how he had successfully manipulated his family and various government agencies into providing him with a comfortable existence involving little effort on his part.

The reasons for the ambivalence of the healthy toward the disabled may be less obvious than for the ambivalence felt by the latter toward the former, but the presence of covert and sometimes overt negative reactions to crippling is well documented.[1] The relative strength of positive and negative attitudes undoubtedly varies a great deal in different unhandicapped people, depending on such factors as the basic personality of the healthy individual involved in the encounter, the type of adjustment pattern employed by the disabled person, the kind and extent of the disability, and its symbolic value to the healthy person. If the disability involves a function which is not only realistically but also symbolically of particular importance to him so that he experiences anxiety when it is brought to his attention, he may feel hostile toward the patient who is responsible for his experiencing such unpleasant sensations. This may be an explanation of the great distress displayed by the mother of one patient, whenever the latter attempted to minimize her difficulty in walking and tried to get up from her wheel chair and get around without its aid. As has been mentioned previously, the demanding, complaining patient may induce feelings of both resentment and guilt in healthy individuals, as, for example, during the first session when I experienced annoyance at one man's whining and exaggerated recital of his ill fortune and shut him off rather peremptorily, later feeling some guilt about the way I had acted. On the other hand, there are people with doubts about their own potency or assertiveness who may experience pleasant feelings of superiority on contact with a cripple, especially one who complains a lot and is openly envious of their own good health. Many well people have a stereotyped, although vague picture of how they expect the disabled to act and feel. As one patient said, "And then people consider you in a different light and you're sort of working in yourself to be as normal as possible, and then you get the feeling that other people expect you not to be normal and they will exaggerate all the symptoms they've heard." This attitude of the well, as experienced by the disabled, may have profound consequences. Since others "don't expect you to be normal" and since you are dependent on them, it becomes necessary to take on a certain role in accordance with what you think they expect of you. You must behave not as an individual but as a representative of a certain class, the class of the disabled. You tend to become dehumanized, an object rather than a person, and you must smother spontaneity and behave carefully and predictably.

Another reason for negative feelings in the healthy toward the disabled occurs in individuals who themselves have marked ambivalent conflicts about dependency. Such people may feel hostility, rationalized on other grounds,

toward the disabled person who arouses within them certain frightening and unacceptable longings. The patients in the group were quite aware of the fact that sometimes they inspired fear and uneasiness in those about them, some of which may be due to this mechanism, although consciously the fear expressed by other people was that the disease might be contagious or that the patients might be affected mentally.

Whatever their source, negative feelings produced in healthy people in contact with the disabled may be expressed in a variety of ways, either directly as overt rejection, indifference, or even cruelty, or indirectly through reaction formations such as excessive sympathy, a prying kind of curiosity, or the sort of pseudohelplessness which prevents the patient from doing as much as he is able to do, thus making him more helpless than he actually has to be. Examples of all these attitudes were frequently reported by members of the group as, for example, the bitterness of one patient when her family openly repeatedly referred to her as "poor Virginia" in a manner which made her feel less than human. My colleague and I were certainly being pseudohelpful when at the beginning of the first meeting we did all the furniture moving ourselves, without allowing patients to help to the extent to which they were able. This made us feel strong and whole and very probably caused them to feel deficient and inferior. The kind of reaction this produces was described by one man who, when he was forestalled in his efforts to pick up a book by somebody rushing to do it for him, then walked over and picked up another one which he did not really want, just to show he could do it. On the other hand, it is certainly true that people can be really helpful in a way that is not devaluating or diminishing and the patients were usually quite sensitive to the different motivations which might underlie an offer of assistance. Thus, in contrast to the above examples of pseudohelpfulness, one patient was quite ready to accept the arm of a man who politely and matter of factly offered it to him when he was stumbling around in the dark one evening. Overt acts of avoidance or rejection were also reported, but less frequently than the more subtle ones. The possibly excessive readiness with which the police were ready to pick up as drunk any patient with an ataxic gait may be in point here.

From the description of some of the possible attitudes and their behavioral manifestations occurring both in the disabled and in the healthy, it can be seen that a very wide variety of patterns of interaction between the two groups is not only possible but indeed is inevitable. For this reason, one should look with suspicion at any sweeping, global generalizations about the social situation of the disabled. As in so many aspects of human behavior, when studying somatopsychologic relationships, things are very often not what they seem and a reliance on what appears obvious may be more comforting then enlightening.

CONCLUSION

The most important practical application which can be drawn from the material reported here is that those who work with the disabled should endeavor to understand as sensitively and perceptively as possible the emotional reactions

of their patients to the disabilities from which they suffer and their own emotional response to crippling and the crippled. Only when these factors and their interaction are kept in awareness will such errors be avoided as the prescription of a wheel chair for a paraplegic who may need one physically but to whom the wheel chair will be a symbol which will precipitate a depression in which he will use his mobility to propel himself to a window and throw himself out of it. Being dependent is not always and per se a bad thing for the handicapped; sometimes it may be more useful to a patient to teach him to accept gracefully the help he requires than to exhort him to get out there and fight. It may even be that some of the fatigue which was complained of so generally by many of the patients in this group is a consequence not only of their physical lesions but also of their unremitting efforts to push themselves beyond their capacities. On the other hand, the knowledge that patients are capable of exploiting their handicap in a manipulative way makes possible a more objective and less guilty attitude toward the problems of this kind of a disabled person.

OL.
9
959

Certainly, the more that is learned about the problems of adjustment to chronic illness and disability, the more one can hope that the day will come when physical and ancillary techniques may be applied with some precision and exactness, and with a reasonable ability to predict how the particular individual involved will react to whatever is happening to him. For the carrying out of research in this field, it is believed that the method of investigation described in this paper has a good deal to offer. This is so because the denial and regressive defenses whose chief manifestations appear in an interpersonal setting can be observed with particular clarity in the interpersonal laboratory provided by the group situation. Processes which might effectively be denied and thus remain obscure to the therapist in a two-person situation are much more likely to be evident to an experienced observer watching interactions within a group.

Although this group was organized for a primarily investigative rather than a therapeutic purpose, experience with it suggests that sessions of this kind with experienced leaders can provide definite benefits for persons with chronic disabilities such as multiple sclerosis. The group provided for its members companionship and an opportunity to discuss freely, in a permissive atmosphere, experiences common to all of them, thus helping to dispel feelings of shame, resentment, and hopelessness. Although it might be thought that a patient who had recently acquired the disease would be frightened by contact with others who were more disabled,[9] and although this may have been one of the reasons for some of the early drop-outs, it was found that some new patients, after an initial period of depression, integrated quite well into the group, and actually derived some measure of reassurance from the experience.

Finally the most striking impression one takes away from a period of involvement with the problems of the disabled, such as described in this paper, is the extent to which the individual and group behavior of these patients is recognizably like the behavior of the nondisabled. I do not mean that there are no differences. There certainly are, and an attempt has been made to describe some of these differences here. But the differences are quantitative rather than qualitative; the group members behaved with each other in ways quite similar to

those seen in other groups organized for very different purposes. Contrary to the experience of Long[2] with another group of patients with multiple sclerosis, the patients in this group were able to express negative feelings toward each other in a fairly lively manner, and to the extent to which expression of feelings was muted it seemed likely that this was more because the group orientation was not primarily a psychotherapeutic one rather than because the patients were disabled. In short, being disabled emphatically did not render these people less human. As a matter of fact, in demonstrating the ability of humans successfully to adapt themselves somehow to the most adverse conditions, they were at the same time demonstrating, in triumphant fashion, the essential quality which has enabled us to survive as a species.

REFERENCES

1. Barker, Roger G.: Adjustment to Physical Handicap and Illness, New York, 1953, Social Science Research Council.
2. Long, Robert T.: Insight Gained Through Group Therapy With Multiple Sclerosis Patients, J. Nerv. & Ment. Dis. **119**:366, 1954.
3. Dembo, Tamara, Ladieu, Gloria, and Wright, Beatrice A.: Adjustment to Misfortune, Final Report to the Army Medical Research and Development Board, Office of the Surgeon General, War Department, April, 1948.
4. Weinstein, Edwin A., and Kahn, Robert: Denial of Illness, Springfield, Ill., 1955, Charles C Thomas, Publisher.
5. Lewin, Bertram D.: The Psychoanalysis of Elation, New York, 1950, W. W. Norton & Company, Inc.
6. Chodoff, Paul: A Re-examination of Some Aspects of Conversion Hysteria, Psychiatry **17**:75, 1954.
7. Orbach, Chas. E., and Bieber, Irving: Depressive and Paranoid Reactions, Arch. Neurol. & Psychiat. **78**:301, 1957.
8. Jaffe, Joseph, and Slote, Walter: Interpersonal Factors in Denial of Illness, Arch. Neurol. & Psychiat. **80**:653, 1958.
9. Chafetz, Morris E., Bernstein, Norman, Sharpe, William, and Schwab, Robert S.: Short-Term Group Therapy of Patients With Parkinson's Disease, New England J. Med. **253**:961, 1955.

VOL 9 195

SURVEY OF 230 MEDICAL PATIENTS IN THE BALTIMORE CITY CHRONIC DISEASE HOSPITAL

DOUGLAS CARROLL, M.D., AND
ELMER MCKAY, M.S.
BALTIMORE, MD.

(Received for publication July 3, 1958)

OL.
9
959

WITH the increasing need for institutional care of patients with long-term illnesses in hospitals and related establishments, it is quite apparent that careful planning is necessary if this problem is to be met effectively during the next ten years. The most efficient care is rendered when patients are placed in institutions appropriate for their needs. Nursing care patients should not be cared for in chronic disease hospitals. Ambulatory patients should be discharged from the hospital. Rehabilitation should be arranged for those in need of it. Patients with chronic diseases should not be allowed to accumulate in hospitals for acute cases. To plan intelligently for the care of such patients it is necessary to have surveys of the existing facilities and personnel. Plans for the building of necessary facilities and the training of personnel should be considered. It is also important to know what types of patients are currently housed in various institutions such as chronic hospitals, nursing homes, and infirmaries. A recent study[1] of the patients in the Municipal Hospitals of New York City has revealed a large number of custodial and nursing care type patients accumulating in these hospitals.

This report is an attempt, using simple methods which might be applicable to any hospital or nursing home, to determine the medical, nursing, and rehabilitation needs of the group of patients in a chronic disease hospital. Such over-all needs may be obscured in the day-to-day care of a large number of patients, many of whom are assumed to need care permanently.

MATERIALS AND METHODS

There were 230 medical patients in the Baltimore City Chronic Disease Hospital on June 5, 1957. Patients with tuberculosis and psychoses are generally transferred from this service to appropriate institutions. The history, physical examination, course, and present status of each patient were reviewed and a card was filled out. The information on the card included the following facts: name, age, sex, race, date of admission, blood pressure, diagnoses, and physical profile. In some cases the age was impossible to obtain because of the mental

Supported by Summer Work Training Program of the State of Maryland Department of Health.

degeneration of the patient. The diagnoses were placed in order of importance as a cause of the patient's hospitalization. Thus, although hypertension might be the underlying etiology of the patient's disease, it was not considered the primary diagnosis, since no patient was admitted because of hypertension alone. The diseases which were actually causing the patient's stay in the hospital were listed in the diagnoses. In the case of patients with hypertension, a cerebrovascular accident, coronary artery disease, or renal failure might have been considered the primary diagnosis. Frequently, there were several major diseases causing the patient's stay in the hospital, and, in these cases, an attempt was made to select the most important cause of hospitalization as the first diagnosis. Uncertainty in this selection is inevitable, so that the chart showing primary, secondary, and tertiary diagnoses must be accepted as approximate.

The physical profile used was a combination and modification of the functional and therapeutic classification of the new York Heart Association,[2] of the disability classification system of Moskowitz and McCann,[3]* and of a specific rehabilitation potential category scale. Eight categories of function were graded and recorded. These were: (1) cardiac (*C*), (2) general physical condition (*P*) (excluding cardiac, neurological, and psychiatric disabilities which are described under different headings), (3) upper extremities (*U*), (4) lower extremities (*L*), (5) sensory (*S*) (speech, vision, and hearing), (6) excretory function (*E*), (7) psychiatric or mental status (*M*), and finally (8) rehabilitation potential† (*R*). Each of these eight categories was graded in numerals according to the situation shown in the following descriptions of categories:

VOL. 9 195

Description of Categories

1. C (*Cardiac*)

This category describes the functional and therapeutic classification of patients with heart disease and follows exactly the criteria for diagnosis of the New York Heart Association. If no heart disease is present, the symbol "0" should be placed here.

Functional Capacity.—

0. No heart disease.

1. Patients with heart disease but without resulting limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea, or anginal pain.

2. Patients with heart disease resulting in slight limitation of physical activity. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitations, dyspnea, or anginal pain.

---

*The system of Moskowitz and McCann is itself a modification of the "Pulhems Profile" used by the Canadian Army as described in "Physical Standards and Instructions. For the Medical Examination of serving Soldiers and Recruits for the Canadian Army, 1943."

†Rehabilitation potential is a prediction (based on the patient's medical, functional, and mental resources and the examiner's experience) as to what level of self-care the patient might be expected to reach using the rehabilitation facilities available. The purpose of this category in this survey is to separate patients who have no possibility of improvement (primarily patients with intellectual degeneration and terminal conditions) from those who might possibly benefit from rehabilitation. This differentiation usually presented no problem after careful review of the patient's medical condition. When there was doubt, the patient was given a trial on rehabilitation. A five-year follow-up of all the patients in this series will show how accurate this evaluation proved to be.

3. Patients with heart disease resulting in marked limitation of physical activity. They are comfortable at rest. Less than ordinary activity causes fatigue, palpitation, dyspnea, or anginal pain.

4. Patients with heart disease resulting in inability to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency or of anginal syndrome are present even at rest. If any physical activity is undertaken discomfort is increased.

Therapeutic Classification (omit, if no heart disease).—

A. Patients with heart disease whose ordinary physical activity need not be restricted.

B. Patients with heart disease whose ordinary physical activity need not be restricted, but who should be advised against severe or competitive physical efforts.

C. Patients with heart disease whose ordinary physical activity should be moderately restricted, and whose more strenuous efforts should be discontinued.

D. Patients with heart disease whose ordinary physical activity should be markedly restricted.

E. Patients with heart disease who should be at complete rest, confined to bed or chair.

OL.
9
959

2. *P (Physical Condition)*

This category includes diseases of the viscera (pulmonary, gastrointestinal, urologic, and endocrine) which are not enumerated in the lettered categories below. (Exclude cardiovascular and neurological.) (Change in *motility* caused by organic neurological diseases are to be described under *U* and *L*. Changes in *mentality* caused by organic neurological diseases are to be described under *M*.)

0. No gross abnormalities considering the age of the individual.
1. Minor abnormalities not requiring frequent medical or nursing supervision.
2. Moderately severe abnormalities requiring frequent medical or nursing supervision, yet still permitting ambulation.
3. Severe abnormalities requiring constant medical or nursing supervision confining individual to bed or wheel chair.

3. *U (Upper Extremities)*

This category includes the shoulder girdle, cervical and upper dorsal spine.

0. No gross abnormalities considering the age of the individual.
1. Minor abnormalities with fairly good range of motion and function.
2. Moderately severe abnormalities, but permitting the performance of daily needs to a limited extent.
3. Severe abnormalities requiring constant nursing care.

4. *L (Lower Extremities)*

This includes the pelvis, lower dorsal and lumbosacral spine.

0. No gross abnormalities with fairly good range of motion and function.
1. Minor abnormalities with fairly good range of motion and function.
2. Moderately severe abnormalities permitting limited ambulation.
3. Severe abnormalities confining the individual to bed or wheel chair.

5. *S (Sensory)*

Sensory components relating to speech, vision, and hearing.

0. No gross abnormalities considering the age of the individual.
1. Minor deviations insufficient to cause appreciable functional impairment.
2. Moderate deviations sufficient to cause appreciable functional impairment.
3. Severe deviations causing complete loss of hearing, vision, or speech.

6. E (Excretory Function)

Bowel and bladder control.

0. Complete control.
1. Occasional stress incontinence or nocturia.
2. Periodic bowel and bladder incontinence or retention alternating with control.
3. Total incontinence, either bowel or bladder.

7. M (Psychiatric or Mental)

Psychiatric, mental, and emotional status.

0. No deviations considering the age of the individual.
1. Minor deviations in mood, temperament, and personality not impairing environmental adjustment.
2. Moderately severe variations requiring some supervision.
3. Severe variations requiring complete supervision.

8. R (Rehabilitation Potential)

This category has to do with the probable long-term disposition of the patient. In this evaluation the medical situation only is to be considered, not the home situation or social factors.

0. Patient has excellent possibility of discharge to infirmary or home in the near future, without wheel chair.
1. With medical care and/or rehabilitation, the patient has a *good* possibility of discharge to the infirmary or to home, without wheel chair.
2. With medical care and/or rehabilitation, the patient has a *fair* possibility of discharge to the infirmary or to home, possibly with a wheel chair.
3. The patient needs only nursing care with occasional medical supervision and could be cared for in a nursing home.
4. The patient needs medical facilities in a chronic hospital for an indefinite period.

Examples of how different patients might be graded follow:

1. An 82-year-old man with mild diabetes not requiring strict dietary control or insulin suffered a mild cerebrovascular accident on an arteriosclerotic basis, with resultant right hemiparesis. He walked with difficulty; aphasia was minimal. On occasion he was incontinent during the night and he had minimal cerebral changes.

The profile would read as follows:

C	P	U	L	S	E	M	R
0	1	1	2	1	1	1	1

2. A 50-year-old woman with rheumatic heart disease and mitral insufficiency had marked limitation in physical activity. She was comfortable at rest, but had anginal pain on exertion. Her physical activity required marked restriction. Amputation of the left leg had been performed, secondary to an embolus and gangrene, but the patient could ambulate with crutches. Her eyesight was poor and she was a Pantopon addict.

The profile would read as follows:

C	P	U	L	S	E	M	R
3D	0	0	2	2	0	2	2

3. A 67-year-old man was brought to the hospital by the police because of disorientation. The patient showed evidence of marked arteriosclerosis, but no organic lesions were demonstrable. He remained completely disoriented. On the third hospital day he suffered a left hemiplegia from which he recovered sufficiently to ambulate, but had little function in the left hand. He wandered around the ward disturbing other patients.

The profile would read as follows:

C	P	U	L	S	E	M	R
0	0	2	1	0	0	3	4

VOL. 9 1959

4. A 60-year-old man suffered a left hemiplegia and was admitted to the hospital. There was incomplete recovery of function, but after several months of rehabilitation, he learned to get in and out of bed, to go to the toilet, and to care for his daily needs. He was found to have severe hypertension, an enlarged heart, with slight exertional dyspnea. On digitalis, these symptoms disappeared.

The profile would read as follows:

C	P	U	L	S	E	M	R
3C	0	2	3	0	0	0	2

RESULTS

The mean age of the 208 patients whose recorded ages were reliable was 70.6 years. More than half the patients were between 61 and 80 years of age with only 19 per cent below 60, and 24 per cent over 81 years of age. The white patients were slightly older than the Negro patients, and there were proportionally more men than women in both white and Negro groups (Table I).

TABLE I. SEX AND RACE BY AGE OF 208 PATIENTS IN CHRONIC HOSPITAL ON JUNE 5, 1957

SEX AND RACE	AGE							TOTAL
	31–40	41–50	51–60	61–70	71–80	81–90	91–100	
Negro male	1	5	11	17	14	3		51
Negro female	1	1		10	7	2		21
White male		1	15	22	17	20	6	81
White female		2	3	9	21	18	2	55
Total	2	9	29	58	59	43	8	208

Table II shows that there is a large turnover in the population of the Chronic Disease Hospital, leaving a few patients to accumulate over the years. The fast turnover is caused by deaths, since few patients are discharged home, to nursing homes, or to an infirmary. The figures for the year 1957 represent only 5 months. Thus, there is a residual group of long-term patients and a larger group which comes to the Chronic Hospital and dies within a year or two.

TABLE II. SEX AND RACE BY ADMISSION DATE IN 230 PATIENTS IN CHRONIC HOSPITAL ON JUNE 5, 1957

SEX AND RACE	YEAR												TOTAL
	BEFORE 1947	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	
Negro male	5			1	3	4	4	4	5	6	10	11	53
Negro female	3	1	3		1	1	3	3	2	6	4	5	32
White male	2	1		1	3	1	6	5	8	16	26	16	85
White female			1	1	1	2	3	6	8	8	17	13	60

TABLE III. PRIMARY DIAGNOSIS OF DISEASES CAUSING ADMISSION TO OR MAKING CONTINUED CARE NECESSARY IN THE CHRONIC HOSPITAL

Respiratory.—
1. Pulmonary emphysema
2. Disseminated tuberculosis

Cardiovascular.—
1. Rheumatic heart disease
2. Arteriosclerotic heart disease
3. Hypertensive cardiovascular disease

Hemic and Lymphatic.—
1. Pernicious anemia with paraplegia
2. Lymphatic leukemia

Urogenital.—
1. Chronic pyelonephritis with uremia

Endocrine.—
1. Diabetis mellitus with neuropathy

Neurological.—
1. Idiopathic epilepsy
2. Epilepsy secondary to brain trauma
3. Peripheral neuritis
4. Parkinsonism
5. Thrombosis of anterior spinal artery
6. Transverse myelitis with paraplegia
7. Traumatic paraplegia

Cerebrovascular.—
1. Thrombosis of cerebral artery with hemiplegia
2. Chronic brain syndrome

Psychiatric.—
1. Mental deficiency

Cancer.—
1. Squamous-cell carcinoma of the palate
2. Prickle-cell carcinoma of the vulva
3. Carcinoma of the liver
4. Metastatic breast carcinoma
5. Carcinoma of the ear
6. Adenocarcinoma of the stomach
7. Carcinoma of the colon

Dermatologic and Syphilis.—
1. Multiple perineal fistulas of unknown etiology
2. Neurosyphilis

Arthritis.—
1. Septic arthritis
2. Rheumatoid arthritis
3. Osteoarthritis

Amputation.—
1. Bilateral amputation

Other.—
1. Blindness
2. Fracture of hip
3. Diffuse collagen disease

VOL. 9 1959

Table III lists the diseases causing admission to the Chronic Hospital or making continued care necessary. Cerebrovascular disease was the leading cause of hospitalization. These patients are the residual of large groups of patients with cerebrovascular disease who have passed through the acute and chronic hospitals over the years. The cause of the disease in the large majority of these patients is cerebrovascular thrombosis. Incontinence, bilateral lesions, aphasia, homonymous hemianopsia, flaccid paralysis, and heart disease are present in many.

An attempt was made initially to divide patients with cerebrovascular disease into two groups, those with neurological evidence of localized brain damage such as hemiplegia and those with signs of diffuse brain damage such as disorientation, incontinence, and coma without localizing neurological signs. The latter group was so small that this division was not considered helpful and all cases of localized and/or generalized cerebrovascular disease were considered as one group.

It is of interest to note how few patients with cardiovascular disease were hospitalized. There was very little valvular heart disease, the majority of cases being coronary arteriosclerosis.

The patients with respiratory diseases were largely those with emphysema, who over a long period of time had developed such restrictions in activity as to be unable to walk far from their beds.

The patients with neurological disease were a few with paraplegia, epilepsy, and peripheral neuritis, and a larger number with paralysis agitans.

Table IV shows primary, secondary, and tertiary diagnoses. Since it was frequently difficult to select the most important disease, this chart gives a better idea of the over-all incidence of the different diseases. Fifty-one patients had a secondary and 16 a tertiary diagnosis of cardiovascular disease, but the large majority of these were in Functional Classification Group I.

TABLE IV. PRIMARY, SECONDARY, AND TERTIARY DIAGNOSES IN 230 PATIENTS IN CHRONIC HOSPITAL ON JUNE 5, 1957

DISEASE CLASSIFICATIONS	DIAGNOSIS		
	PRIMARY	SECONDARY	TERTIARY
Respiratory	8		3
Cardiovascular	11	51	16
Hemic and lymphatic	4	2	1
Digestive	2	3	1
Urogenital	1	3	0
Endocrine	4	12	5
Neurological	20	6	0
Cerebrovascular	136	21	3
Psychiatric	4	4	0
Cancer	8	3	2
Dermatologic and syphilis	2	4	1
Arthritis	10	4	2
Amputation	7	2	0
Other	13	11	5

TABLE V. PRIMARY DIAGNOSIS AND DECADE OF 230 PATIENTS IN CHRONIC HOSPITAL ON JUNE 5, 1957

PRIMARY DIAGNOSIS	AGE								TOTAL
	31-40	41-50	51-60	61-70	71-80	81-90	91-100	UNKNOWN	
Respiratory			3	3		2			8
Cardiovascular			2	2	2	2		3	11
Hemic and lymphatic			1		2			1	4
Digestive		1	1						2
Urogenital					1				1
Endocrine					3		1		4
Neurological	1	2	7	5	3			2	20
Cerebrovascular		2	10	37	37	30	6	14	136
Psychiatric			1		2	1			4
Cancer		3	1		2	2			8
Dermatologic and syphilis				1	1				2
Arthritis	1		2	3	2	1		1	10
Amputee		1		4	1	1			7
Other			1	3	3	4	1	1	13
Total	2	9	29	58	59	43	8	22	230

TABLE VI. RACE AND SEX OF 230 PATIENTS IN CHRONIC HOSPITAL WITH PRIMARY DIAGNOSIS

PRIMARY DIAGNOSIS	NEGRO MALE	NEGRO FEMALE	WHITE MALE	WHITE FEMALE	TOTAL
Respiratory	1		6	1	8
Cardiovascular	3	2	2	4	11
Hemic and lymphatic			2	2	4
Digestive			2		2
Urogenital			1		1
Endocrine			3	1	4
Neurological	7	2	9	2	20
Cerebrovascular	27	23	46	40	136
Psychiatric	3		1		4
Cancer	1	1	3	3	8
Dermatologic and syphilis	1	1			2
Arthritis	2		3	5	10
Amputation	5	1	1		7
Other	3	2	6	2	13
Total	53	32	85	60	230

VOL 9 195

Table V shows the diagnosis and age of the patients at the time of the study. Cerebrovascular disease was present relatively late and increased in incidence with age.

Table VI shows an equal incidence of cerebrovascular disease in the white and Negro population. Seven patients with respiratory disease had pulmonary emphysema, a condition which seems to be more common in white males.

Table VII shows that the long-term patients usually had neurological disease, cerebrovascular disease, or deforming rheumatoid arthritis.

Table VIII is a summary of the categories into which all 230 patients were placed. For example, under vertical column U, we see "28" opposite horizontal row 3. This datum indicates that there were 28 patients who had severe abnormalities of the upper extremities requiring constant nursing care. Among other points, this chart shows that there were relatively few (6) patients in severe cardiac difficulty, that many patients had difficulty with walking or were bed patients (143), that there were a large number (41) with severe disabilities of sight, speech, or hearing, that 83 patients were completely incontinent. Under *R* one can see that relatively few were amenable to rehabilitation; 139 were considered to require principally nursing care, and 42 prolonged close medical supervision.

This table therefore gives an over-all view of the cardiac, functional, and rehabilitation status of all patients at the time of study.

Table IX gives in detail the cardiac, physical profile, and rehabilitation category for each diagnostic group. The chart demonstrates the large number of patients with mild heart disease. The disability of patients with cerebral vascular disease is apparent, as well as the loss of speech, hearing, or vision (usually the former), the loss of bladder or bowel control, and the mental deficits.

Table X shows that patients who might be expected to benefit from rehabilitation are slightly younger than the nursing home patients or patients who need prolonged medical care.

Table XI demonstrates that a few patients judged to have some possibility of rehabilitation have been in the hospital for long periods of time.

Table XII shows that neurological and cerebrovascular diseases make up the majority of diseases in the nursing home and medical care categories.

Table XIII shows that the males seem to have slightly higher rehabilitation potential.

Table XIV shows the relation of age to rehabilitation potentials. Categories 0, 1, and 2 are those in which there is some hope of getting the patient sufficiently well to leave the hospital. Categories 3 and 4 are those for nursing home patients and those needing prolonged medical care. The percentage of patients potentially able to be rehabilitated in the age groups starting at 31-40 and going through 91-100 are 50, 45, 26, 22, 30, and 0, respectively.

Table XV shows that nearly 50 per cent of the Negroes had hypertension.

DISCUSSION

A major problem facing many medical institutions is the accumulation of patients with chronic diseases, filling beds which might be more efficiently used for patients with acute diseases.

TABLE VII. YEAR OF ADMISSION OF 230 PATIENTS IN CHRONIC HOSPITAL ON JUNE 5, 1957

PRIMARY DIAGNOSIS	YEAR											
	BEFORE 1947	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Respiratory										1	1	6
Cardiovascular							2	1		1	4	3
Hemic and lymphatic								1	1		1	1
Digestive											2	
Urogenital											1	
Endocrine							1				3	
Neurological	1		1	1	2		2	1	1	4	5	2
Cerebrovascular	4		2	2	5	6	9	14	13	25	29	27
Psychiatric									2	1	1	
Cancer							1		1		6	
Dermatologic and syphilis									1	1		
Arthritis	3		1							1		5
Amputation	1				1			1	1	1	1	1
Other	1	2				2	1		3	1	3	
Total	10	2	4	3	8	8	16	18	23	36	57	45

VOL. 9 1959

TABLE VIII. AN OVER-ALL VIEW OF THE NUMBER OF PATIENTS IN EACH CATEGORY OF THE PHYSICAL PROFILE

	C	C	P	U	L	S	E	M	R
A*–0	89	107	129	120	59	129	99	104	24
B–1	121	25	71	41	28	42	12	82	11
C–2	14	7	22	41	32	18	36	30	14
D–3	5	3	8	28	111	41	83	14	139
E–4	1								42

*A, B, C, D, and E refer to the Therapeutic Classification of cardiac patients in column 2 only.

VOL.
9
1959

To plan for future care, a survey of the patients in the institution is of help. The survey should be oriented both toward the diagnosis of the patient's disease and toward what he is able to do. Those who show some prospect of benefiting from rehabilitation should be selected and treated.

This survey is an attempt to fulfill these purposes. The emphasis here is on simplicity. Detailed and exhaustive surveys have been made by some investigators, and these surveys are of great importance. Most institutions, however, will be unable to undertake such elaborate studies, and the present survey is undertaken to explore the effectiveness of a very simple classification.

It should be emphasized that, although the diagnosis is of primary importance in treatment and prognosis, an estimation of what the patient is able to do for himself is primary in selecting the type of accommodation which should be provided.

Another important aspect is rehabilitation. The frequently glowing reports from rehabilitation centers, utilizing large numbers of medical and paramedical specialists and expensive apparatus have made some doctors think that nothing can be accomplished by simple methods in a general hospital. With this opinion we heartily disagree. Although the rehabilitation centers are generally better equipped to meet the most difficult problems of rehabilitation, there will certainly never be enough of them to take care of all patients needing rehabilitation. Rehabilitation should be as much a part of the patient's treatment in a chronic disease hospital as is the use of drugs.

There are few patients with chronic diseases who cannot derive some benefit from rehabilitation. Some may be taught to get in and out of bed, others may be taught to use a wheel chair. In this study we have oriented and evaluated our rehabilitation efforts in terms of the discharge of patients. This is a clear-cut end point and the major purpose of rehabilitation in a chronic disease hospital. It is by no means the only purpose of rehabilitation; it is used in this study for simplicity and precision.

Effectiveness of the Survey Method.—The conclusion from this study is that a survey of the kind described in this paper is helpful in identifying the needs of different types of patients. It was felt that all patients could be fitted into three

TABLE IX. CARDIAC AND PHYSICAL PROFILE FOR DIFFERENT DIAGNOSES

PRIMARY DIAGNOSIS	C										P				U				L				S				E				M				TOTAL
	0	1	2	3	4	A	B	C	D	E	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	
Respiratory	2	2	2	2		1	2	2	1			3	3	2	6	1	1		5	1	2		7	1			7			1	3	4		1	8
Cardiovascular		4	3	3	1	3	3	3	2		9	2			7	3		1	6	2	1	2	5	5		1	7	1	2	1	5	3	2	1	11
Hemic and lymphatic	1	3				3					1	2	1		4				2	1	1		2	1	1		4				2	2			4
Digestive	2												2		2				2				2				2				2				2
Urogenital		1				1							1		1				1				1				1				1				1
Endocrine	1	3				1	2				1	2	1		4				3			1	3			1	3			1	3		1		4
Neurological	14	6				6					8	7	3	2	10	3	5	2	4	3	2	11	14	3	1	2	7	2	4	7	9	8	1	2	20
Cerebrovascular	43	88	5			81	10	2			91	40	4	1	54	28	32	22	26	12	18	80	69	23	15	29	35	8	22	71	50	54	23	9	136
Psychiatric	2	2				1	1				1	2	1		3	1			1	2	1		2	2			2		2			2	1	1	4
Cancer	6	2				1	1					1	4	3	6	1		1	2	3	2	1	5	2		1	8				8				8
Dermatologic and syphilis	2												2		2				1	1			1	1			1		1		2				2
Arthritis	5	2	3			1	4				8	2			5	1	2	2			1	9	10				8		2		7	3			10
Amputation	3	4				3	1				2	5			6	1				1	2	4	5	2			6		1		5	2			7
Other	8	4	1			5	1				8	5			10	2	1		6	2	2	3	3	2	1	7	8	1	2	2	7	4	2		13

VOL. 9 1959

TABLE X. MEAN AGE OF 208 PATIENTS IN DIFFERENT REHABILITATION CATEGORIES, JUNE 5, 1957

REHABILITATION CATEGORY	MEAN AGE
R–0	68.4
R–1	63.0
R–2	67.1
R–3	71.9
R–4	70.7

TABLE XI. REHABILITATION CATEGORIES BY YEAR OF ADMISSION OF 230 PATIENTS IN THE CHRONIC HOSPITAL, JUNE 5, 1957

REHABILITATION CATEGORY	YEAR OF ADMISSION											
	BEFORE 1947	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
0			1	1		1	3		1	4	10	3
1							1	1	1		3	5
2	1				1			1	2	1	4	4
3	8	2	3	2	4	4	11	15	18	21	35	16
4	1				3	3	1	1	1	10	5	17
Total	10	2	4	3	8	8	16	18	23	36	57	45

groups: (1) those requiring only nursing care; (2) those requiring prolonged medical care; and (3) those who have some expectation of discharge, frequently with the help of rehabilitation.

It has been found, furthermore, that with careful evaluation the patients generally remain in the group to which they were originally assigned. To be sure, patients primarily needing nursing care at some time in their course may need medical care for acute illnesses, but after these episodes have been treated they will still remain in the original group. Patients requiring constant medical care may in time reach a stage where nursing care only is needed, but this situation is unusual. Patients originally thought to be good candidates for rehabilitation may not fulfill expectations or may regress medically, but this chain of events is the exception rather than the rule. A follow-up has shown that the members of each group for the most part remain in that group. Most patients admitted to the Baltimore City Hospitals have been observed previously in a hospital for acute diseases, and it is generally possible to predict what group they belong in at the time of admission or after several weeks of observation.

It must be emphasized that rehabilitation was directed mainly toward patients with some prospect of discharge. It is recognized that many of the patients

TABLE XII. REHABILITATION CATEGORY BY PRIMARY DIAGNOSIS IN 230 PATIENTS IN CHRONIC HOSPITAL JUNE 5, 1957

REHABILITATION CATEGORY	PRIMARY DIAGNOSIS													
	RESPIRATORY	CARDIOVASCULAR	HEMIC AND LYMPHATIC	DIGESTIVE	UROGENITAL	ENDOCRINE	NEUROLOGICAL	CEREBROVASCULAR	PSYCHIATRIC	CANCER	DERMATOLOGIC AND SYPHILIS	ARTHRITIS	AMPUTATION	OTHER
0	2	4	3	2	1	1	2	3		1			2	3
1			1			1	2	5				1		1
2	2						1	6	1			2	1	1
3	2	3				2	11	96	2	4	1	6	4	8
4	2	4					4	26	1	3	1	1		
Total	8	11	4	2	1	4	20	136	4	8	2	10	7	13

TABLE XIII. REHABILITATION CATEGORY BY RACE AND SEX OF 230 PATIENTS IN THE CHRONIC HOSPITAL, JUNE 5, 1957

REHABILITATION CATEGORY	RACE AND SEX				
	NEGRO MALE	NEGRO FEMALE	WHITE MALE	WHITE FEMALE	TOTAL
0	9	1	11	3	24
1	5		4	2	11
2	3		6	5	14
3	32 (60%)	26 (82%)	43 (50%)	38 (63%)	139
4	4 (7%)	5 (15%)	21 (25%)	12 (21%)	42
Total	53	32	85	60	230

TABLE XIV. REHABILITATION CATEGORY BY AGE OF 208 PATIENTS IN CHRONIC HOSPITAL, JUNE 5, 1957

REHABILITATION CATEGORY	AGE							
	31–40	41–50	51–60	61–70	71–80	81–90	91–100	UNKNOWN
0	1	1	3	7	7	5		2
1		1	5	2	2	1		
2		2	3	3	2	4		
3	1	3	13	36	35	24	7	15
4		2	5	10	13	9	1	5
Total	2	9	29	58	59	43	8	22

TABLE XV. NUMBER OF PATIENTS WITH SYSTEMIC ARTERIAL HYPERTENSION OVER 150/90 MM. HG BY AGE, RACE, AND SEX

RACE AND SEX	AGE								TOTAL	PER CENT*
	31–40	41–50	51–60	61–70	71–80	81–90	91–100	UNKNOWN		
Negro male		2	9	6	5	1		2	25	49
Negro female			1	6	3			10	20	48
White male			2	5	6	4	1	2	20	22
White female			1	3	10	6	2		22	40
Total		2	13	20	24	11	3	14	87	

*Per cent of total number of patients of known age in particular group.

requiring predominantly nursing or medical care might have benefited slightly from rehabilitation as far as helping themselves in the hospital is concerned; few or none could progress to discharge.

This point has been proved in several cases. A few patients in the nursing care and medical care group have been tried on extensive rehabilitation training, but none has any prospect of discharge.

Cerebrovascular disease was the reason for hospitalization in well over half the patients (136). These patients may live for long periods of time. Eighty-eight had mild heart disease in addition to cerebrovascular disease. Twenty-two were unable to feed themselves, 88 could not walk, 71 were completely incontinent, and an additional 30 were occasionally incontinent. All these disabilities made particularly difficult nursing problems. Only 14 of these patients were thought to have any possibility of discharge with rehabilitation.

It is obvious from this study that the physical profile gives far more information on the rehabilitation potential than does the primary diagnosis. The small number of patients potentially capable of rehabilitation in the Chronic Hospital is largely caused by the selection of patients before they are admitted.

There were few patients with heart disease or cancer. There are several possible reasons for this lack of patients with these diagnoses. Most patients with heart failure can be brought to cardiac compensation with a relatively short stay in the hospital. If compensation cannot be achieved, the patient generally dies within a short period. In the case of cancer, the course is usually short. If not, the end is in view, and the family is willing to make sacrifices for the patient which they are unwilling to make when there is no predictable end point as in the case of cerebrovascular disease. Therefore, the patient with cancer is kept at home.

The Utilization of Beds.—The final results of the survey show clearly that 60.4 per cent of the medical patients in the Chronic Hospital could be cared for in nursing homes. For various reasons, these patients have not been transferred to nursing homes. The principal reason is a shortage of nursing home beds and an unwillingness on the part of many nursing homes to accommodate welfare patients requiring a good deal of nursing care. The result is that an excessive amount of the time of trained personnel has to be used where less expert and cheaper facilities would be more efficient. To the extent that such patients accumulate, the chronic disease hospitals will fail in their purpose as hospitals and become nursing homes.[4]

About 18 per cent of the patients required continuous medical care. The majority of these were patients with cerebrovascular disease. Some were senile wanderers who could not be cared for in a nursing home, others were receiving tube feeding or had associated diseases, especially pulmonary and urinary infection, requiring intermittent therapy. A few cancer patients were being treated with drugs, but in the majority of cases the continuous medical care administered held out little hope of returning the patient to the community. Medical treatment in this Chronic Disease Hospital was mainly concerned with complications such as pneumonia and urinary infections and often resulted only in

prolongation of life without change in the underlying condition causing hospitalization. Some of these patients could have been cared for in mental hospitals and some in particularly well-equipped nursing homes, but it seems logical that this type of patient is the legitimate concern of a chronic disease hospital.

Only 21 per cent of the patients showed some possibility of discharge home or to a domiciliary type of institution. Some of these had had previous short admissions for cardiac or respiratory compensation, and a few were recuperating after treatment on the acute medical ward. A little more than one half had conditions amenable to treatment in the Department of Physical Medicine and Rehabilitation. This is the group which benefits most from the facilities available in such a hospital. The community benefits through the return of these patients to their homes, resulting in the opening of more beds for such patients. The hospital benefits in being able to attract greater numbers of nursing and medical personnel to a more hopeful and active service.

VOL.
9
1959

SUMMARY

A survey of 230 medical patients in a Chronic Disease Hospital was made, with particular attention to the functional status of the heart, extremities, mentation, senses (hearing, speech, and sight), bowels and bladder. The primary diagnosis and rehabilitation potential were recorded in each case.

The information collected showed that the patients fall into three fairly stable groups: (1) those requiring mainly nursing home facilities; (2) those requiring constant medical and nursing care; and (3) those with some hope of discharge to home or to a domiciliary type of institution provided intensive medical and/or rehabilitation procedures can be applied.

The survey showed that 139 (60.4 per cent) patients were nursing care patients, 42 (18.3 per cent) needed constant medical and nursing care, and 49 (21.3 per cent) showed possibilities of discharge with rehabilitation or intensive medical care.

Correlations of age, time in the hospital, diagnosis, and functional capacity with rehabilitation potential show that functional capacity is far more important in predicting a patient's potential return of function than any other item.

REFERENCES

1. Rusk, Howard A., Silson, John E., Novey, Joseph, and Dacso, Michael M.: Hospital Patient Survey. Goldwater Memorial Hospital, Welfare Island, New York, 1956.
2. Criteria Committee of the New York Heart Association: Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Blood Vessels, ed. 5 New York, 1953.
3. Moskowitz, Eugene, and McCann, Cairbre: Classification of Disability in the Chronically Ill and Aging, J. CHRON. DIS. **5**:342, 1957.
4. Fritz, Herbert G.: Little Progress in Providing Nursing Home Facilities, Maryland State Department of Health Bulletin **30**:2, 1958.

Editorial

URBAN RESERVOIRS OF TUBERCULOSIS

The course of tuberculosis in urban centers can be divided historically into three stages. The first, the stage of generalization, is characterized by the almost universal prevalence of tuberculous infection. Data obtained from tuberculin test surveys and clinical and pathologic examinations, fragmentary as they may be, indicate that the overwhelming majority of individuals have been infected before they reach late adolescence. The number of new cases reaches its peak in the twenties and thirties, particularly in women, and then declines rapidly. The age curve of mortality from tuberculosis, which parallels that of morbidity, is at its highest point in the third decade of life. During the first stage tuberculosis is a disease of young men and young women.

The basic pattern of tuberculosis is not altered by the variations in infection, morbidity, and mortality rates which exist in this period. A high proportion of the populace is infected early in so-called "good" as well as "bad" neighborhoods. Clinical tuberculosis makes its appearance among the rich as well as the poor, and tuberculosis ranks high as a cause of death in all sections of the city and all occupational groups.

Our efforts at the control of tuberculosis in the stage of generalization are largely governed by its widespread prevalence. The attack is a general one, unrestricted as to place or population. Attempts are made to check the spread of infection through concentration on the media of its transmission, be they air, milk, food, clothing, or the surfaces of the walls and floors. Disinfection and fumigation are widely practiced. Emphasis is placed on case-finding in the office of the private practitioner, in the clinic, and in the hospital. A campaign of health education is prosecuted vigorously through lectures, printed material, and other mass media in every walk of life and section of the city.

Primarily as a result of these measures, and improvement in socioeconomic conditions, the next stage, the stage of localization, is reached. Tuberculosis is no longer generally prevalent but is now largely confined to certain specific groups. In younger age groups the level of tuberculous infection is low. Older people, the survivors of an earlier period when the disease was widespread, usually still exhibit a positive reaction to the tuberculin test. New infections occur relatively infrequently and then only under special circumstances. These

---

Given at the Conference on "Tuberculosis: A World-Wide Problem" at the Hotel Biltmore, Nov. 18, 1958, and published simultaneously in this JOURNAL and in the *American Review of Tuberculosis and Pulmonary Diseases.*

VOL
9
195

fall predominantly into two categories, which are often closely related. One is the result of the spread of tuberculosis from one household member to another, usually in the same family. The other is under the crowded conditions characteristic of low socioeconomic areas, where the presence of individuals with tuberculosis in communicable form makes the dissemination of infection inevitable.

These changes in tuberculosis infection markedly alter the general age specific curves of tuberculosis morbidity and mortality. The number of newly reported cases of tuberculosis in young individuals, which follow closely on conversion of the tuberculin reaction, falls sharply. The peak of the morbidity curve in the 20- and 30-year age group, characteristic of the stage of generalization, is obliterated. The reduction in morbidity, however, is not equal for all groups and in all sections of the city. In the crowded slum, often largely inhabited by minority groups and recent migrants from more heavily infected areas, tuberculosis remains an important problem of youth. This is also true in households anywhere which include individuals with tuberculosis in communicable form among their members.

OL.
9
959

The elderly, on the other hand, are not appreciably affected by the lower incidence of tuberculous infection in the community. Most older people had their first contact with the tubercle bacillus in their teens and have been reactors to the tuberculin test ever since. They represent the survivors of the stage of generalization which prevailed in large cities during the early years of this century. The development of active tuberculosis in this group, and particularly in its male members, is due to the low level of resistance attendant on their way of living and possibly to undefined physiologic stresses related to age. Since these are factors which change very slowly, no reduction in tuberculosis morbidity comparable to that in youth is noted in older age groups. In fact, though the total number of newly reported cases of tuberculosis may remain stationary or decline, the proportion occurring in individuals over 45 increases steadily. As a result, the highest morbidity rate during the stage of localization is found beyond age 65, even in cities with large populations belonging to minority groups, many of whom have recently arrived. A similar trend is found in the age distribution of deaths from tuberculosis, with the peak mortality rate occurring at the very extreme of life.

At this stage selective application of measures for the control of tuberculosis rather than the general approach of earlier years is required. Older persons, who represent the major urban reservoir of tuberculosis, must receive the highest priority. Case-finding must be concentrated in the locations where older men are to be found. Fortunately, these can readily be identified in most large cities, and include shelters, rooming houses, jails, and inpatient and outpatient services of municipal hospitals. Routine chest x-ray examinations must be made available to all of these facilities.

Once detected, tuberculosis must be treated promptly and vigorously in this group for the instability of its members is well recognized. Early institutional care, provided by compulsory methods if necessary and carried on to the stage of noninfectiousness, is essential. Successful hospital treatment must be followed

by long intervals of clinic supervision to guard against relapse. Those patients in whom therapy fails to produce or maintain arrest of their disease will require long-term institutional care in a hospital or other facility designed for this purpose. Most important, the living standards of these older men, many of whom are living a marginal existence, must be raised to a level where tuberculosis is less apt not only to reactivate but even to develop in the first place.

As indicated previously new tuberculous infections usually manifest themselves in younger individuals whose contact with the tubercle bacillus originates in their own household or the neighborhood in which they live or work. The tuberculin test finds its real usefulness as a case-finding method in the identification of this group. It should be used extensively in low economic areas, starting with the high school population, and the reactors should receive both initial x-ray examination and periodic follow-up. When tuberculin testing is not feasible, the mass x-ray technique should be employed directly, but such surveys should be confined to sections in which tuberculosis is prevalent. Every effort should be made to discover the source of each new infection. B.C.G. and isoniazid offer promise in the prevention of these fresh cases, and immediate treatment in a modern hospital the best guarantee for their recovery.

The last stage, the stage of individualization, has not yet been reached in any large city. Its realization is dependent on the exhaustion of the urban reservoirs of tuberculosis. This can occur only when the infected older generations have passed through their life span and the congested population centers which breed new infections have been eliminated or controlled. At that time tuberculosis will manifest itself as an isolated phenomenon, an individual case, or small outbreak. These incidents may happen at any age and will usually be related to recent exposure to the tubercle bacillus. Epidemiologic investigation of each such occurrence should insure prompt detection of the source of the infection. Control measures on an individual basis can then be applied with every prospect of success. In carrying these out, the principal responsibility will fall on the private practitioner. He will need assistance in the form of consultation facilities and this is best furnished by a health department with years of experience with this disease. A public health agency can also be expected to continue to provide service in those areas and groups not under private care. Its primary function, however, will be in a standby capacity, ready to act should situations develop which show signs of getting out of control. As Frost has so brilliantly demonstrated, when this point is reached, and cases of tuberculosis do not reproduce themselves, the eradication of the disease will be in sight.

How do these considerations affect New York City, and where does it now stand in terms of the historical perspective? To the extent that the number of deaths, newly reported cases, positive tuberculin reactors, and other figures permit one to judge, this city has emerged from the stage of generalization and has entered the stage of localization of its tuberculosis problem. In the early part of this century tuberculosis was widely prevalent in New York. More than 30,000 cases and 10,000 deaths from tuberculosis were reported among a total population of less than five million in the year 1910. Not until the 1930's did the number of new cases annually fall below 10,000; and as late as 1938 almost

half of the high school population were reactors to the intermediate strength intradermal tuberculin test. During this period our program had as its primary objective the control of the spread of infection. It emphasized sanitary supervision in the home through visiting by public health nurses, x-ray examination of the entire adult population, increasing use of tuberculosis hospital beds, and the general health education of the public.

The close of World War II brought with it an era of unparalleled prosperity and saw the development of specific antimicrobial therapy for tuberculosis. The general application of the latter to patients with active tuberculosis in and outside of hospitals led to a precipitous decline in the frequency of tuberculous infection. By 1953 the tuberculin reaction rate in high schools, which had been more than 45 per cent in 1938, was down to less than 15 per cent. The general morbidity rate in 1957 was one-ninth and the mortality rate one-thirteenth of the rates for 1910.

The decline was not uniform, however, and led to wide disparities in the extent of tuberculosis in different sections of the city. The tuberculin reaction rate was found to be ten times as high in the schools of some districts as in others. The number of new cases reported in 1957 in the Lower East Side District was over 900, in the Gravesend District with a larger population only 66. Death rates by health center district ranged from 46 to 2.6 per 100,000 population during the same year.

These geographic differences in the distribution of tuberculosis can be closely correlated with the socioeconomic characteristics of the areas represented, and their age, sex, and racial composition. At one extreme we find the shabby hotels and rooming houses of lower Manhattan with a preponderance of elderly men and the crowded tenements of upper Manhattan and lower Brooklyn and the Bronx occupied by young Negro and Puerto Rican families. In both situations tuberculosis is commonplace, resulting from the breakdown of long-standing infections or the acquisition of new ones. At the other extreme are the prosperous middle class neighborhoods of one and two family houses in which tuberculosis has become so rare as to almost constitute an exotic disease.

Long-range plans or predictions in a disease which is changing as rapidly as tuberculosis are difficult. However, continuation of certain present trends can be anticipated.

The current thinking and program of the New York City Department of Health are based on a clear recognition of the facts as they exist today and the further fact that change in this field is rapid and constant. The activities in the Department have changed significantly in recent years.

In New York City tuberculosis is now a sharply localized problem and our attack is being concentrated on local reservoirs of infection. Preventive measures like B.C.G. and the prophylactic use of isoniazid must be and are being applied to contacts in such reservoir areas where the risk of infection is great. Emphasis is being placed on the routine x-ray examination of all hospital patients, on those getting public relief, and on the residents of selected areas where we believe our work will be most productive.

Facilities for treatment and isolation are being concentrated where they appear to be most needed. In providing these, we try to strike a proper balance between short-term and long-term care, and inpatient and outpatient service. Constant emphasis is being placed on all aspects of social help to the tuberculous and their families. This includes attention to housing and nutrition, to help in rehabilitation, and to other social welfare services for the tuberculous and for their families. More and more we view the handling of the tuberculosis problem as involving not only the patient, but also his family and the relation of the patient and family to the community.

Official agencies have always provided the bulk of services for the underprivileged groups with whom we are now especially concerned and where the bulk of the cases are now found. This trend, toward giving most help through official agencies, will undoubtedly be intensified and calls for close cooperation among all. Proper handling in the future will undoubtedly involve even closer cooperation. Cooperation must, of course, be based on intelligent understanding by all the participating agencies of the ever-changing nature of the total tuberculosis problem.

VOL. 9 1959

We have found that the Interdepartmental Health Council, which represents the Departments of Health, Hospitals, Welfare, and the Community Mental Health Board, is a good mechanism for establishing and maintaining such working, fruitful cooperation.

One may well ask: "Is there a place for voluntary bodies like the tuberculosis associations at this stage of tuberculosis control and will they have a role in the future?" The answer is unequivocal: "Yes, of course, if the goal of control of tuberculosis is to be achieved."

The tuberculosis associations can still play their traditional role in health education and the interpretation to the public of the meaning of the tuberculosis problem. Now and in the future, they must help to establish pilot studies and trial programs in different areas. There are indications that the associations are willing and anxious to do exactly these things.

The changing focus in tuberculosis, with its emphasis on localized reservoirs of disease, brings the tuberculosis association and the official agency even closer together than in the past. Most important, the transition from the stage of localization to that of individualization offers a new challenge to groups like those sponsoring this meeting. The spread of tuberculosis on an individual basis and the increasing importance of the private practitioner in its control call for the development of new techniques and approaches to both public and profession.

Experimentation and imaginative thinking are still needed. The voluntary agency, by its nature, can often be more venturesome and more imaginative than are official agencies or private practitioners. Opportunity for leadership is there. I have faith that such opportunities will be embraced.

Leona Baumgartner
Commissioner
Department of Health
New York City, N.Y.

Book Reviews

EPILEPSY. By Manfred Sakel, M.D. New York, 1958, Philosophical Library, Inc. Pp. 204. Price $5.00.

This book is one of the most pseudoscientific treatises written on the subject of epilepsy in recent times. The author attempts to develop his own theories about the neurohumoral basis of idiopathic epilepsy. A good share of the book is devoted to the postulate that an idiopathic convulsion is a self-defense mechanism caused by a sudden unaccountable hyperinsulinemic vagotonia. He carries this analysis further with the thesis that an idiopathic convulsion is the outcome of the fight for supremacy between the vagus, externally overstimulated by insulin, and the sympathicus, overcompensated by internal provocation of the adrenocortex.

This is largely unsubstantiated speculation, and when he advocates as one form of treatment of epilepsy the grafting of additional hyperactive Basedow thyroid into the thyroid of patients with idiopathic seizures he attains a pinnacle of absurdity. He arrives at this ill-conceived conclusion from a study of three patients.

The only positive contribution of the book is a sensible discussion of the psychiatric and social aspects of epilepsy. Here, the author shows genuine empathy for patients with convulsive disorders. He wisely elaborates on the theme that the effort to rehabilitate so many individuals unjustifiably disabled by the misconceptions and fears of the public is highly worthwhile and cannot be overstressed. He clearly points out the community obligation to the patient with epilepsy in an integrated society.

Apart from this, however, the book has little value. The use of the first person pronoun is carried to the extreme of being annoying and repugnant. In light of our present knowledge of epilepsy, a book such as this contributes nothing, but only confuses the entire problem.

Charles N. Luttrell

NEUROLOGICAL BASIS OF BEHAVIOUR. Ciba Foundation Symposium. Edited by G. E. W. Wolstenholme, O.B.E., M.A., M.B., B.Ch. and Cecilia M. O'Connor, B.Sc. Boston, 1958, Little, Brown & Co. Pp. 400, indexed. Illustrated. Price $9.00.

Most scientists who conduct research on brain function have one common and ultimate aim—to explain behavior in terms of more molecular events. This doctrine, reductionism, is neither universally accepted nor universally conceded as feasible. Both pessimists and optimists can find support for their views in the contents of this symposium, which was held to commemorate the centenary of Sherrington's birth. Sherrington, incidentally, was a pessimist.

To this reviewer, the optimists seem to have gained a slight edge, mainly because advances in neurophysiologic technique and a better grasp of behavioral variables have enabled workers like H. H. Jasper and his group to begin to specify where to look for the appropriate neural variables. The other papers that interested me most were those by Richter on the effects of severe stress and by Harris, Michael, and Scott on the neurologic site of action of stilbesterol.

The discussions that followed each paper were transcribed and edited and are often as interesting as the paper itself. They also make one gasp at the enormous range of knowledge displayed by Professor Heinrich Klüver. No journal extant seems to have escaped his curiosity.

Bernard Weiss

SCHIZOPHRENIA. By Manfred Sakel. New York, 1958, Philosophical Library, Inc. Pp. 335, indexed. Price $5.00.

This perhaps historically interesting book presents more the personal beliefs and experiences of the author than an objective appraisal of the general knowledge about schizophrenia. Obviously, Sakel wrote it in support of his "insulin shock treatment" and as a reaction against psychiatric schools which overemphasize the psychologic aspects of psychoses. Thus biased, he tries in the first part of the volume (man and his mind, classification, etiology, symptomatology, general psychopathology, etc.) to convince the reader than the "Sakel insulin treatment" is the best and physiologically most appropriate therapy for schizophrenia and devotes to it the second part, a full 148 pages. This would be quite understandable, since the scientist usually likes his own spiritual child. However, the material is poorly organized, with frequent repetitions, unnecessary details, and gross omissions. For instance, for drugs such as chlorpromazine and reserpine, a total of seven sentences was regarded as sufficient. Other types of therapy receive a similarly cursory treatment whereas a rather naïve assumption of brain cell function in relation to insulin therapy is described on three different occasions. Quite irritating also is the continuous mélange of valuable clinical observations and highly controversial theoretical assumptions, the latter, in many instances, being presented as statements of fact. One misses any information on follow-up studies on patients treated by the author's method. The book has no adequate bibliography.

For the critical reader Sakel's *Schizophrenia* may offer valuable knowledge derived from the extensive experience of the author, particularly in the area of insulin therapy. The psychiatrically uninformed reader, however, might easily be misled and confused and would be safer using one of the leading textbooks on psychiatry for reference.

Rudolf Höhn

PATHOPHYSIOLOGY IN SURGERY. By James D. Hardy. Baltimore, 1958, The Williams & Wilkins Co. Pp. 704, indexed. Price $19.00.

This book constitutes an accomplishment which a good many surgeons put aside for themselves to be done at some time in their careers but which Dr. Hardy actually has done. It is a combination of the many points of view that must be brought to bear on modern surgical problems. An effort has been made to apply basic physiologic and chemical principles to surgical pathology and physiology, while not forgetting the clinical problems of the patient. An effective and concise approach has been made to complicated but important areas such as the metabolic response to injury and stress, acid-base balance, water and electrolyte relationships, and hormonal mechanisms.

Certainly this book represents a useful compilation of our present state of knowledge in pathophysiology in surgery.

James P. Isaacs

CLINICAL EPIDEMIOLOGY. By John R. Paul, M.D., Sc.D. Chicago, 1958, University of Chicago Press. Pp. 291, indexed. Price $5.00.

This volume is one of "The Scientist's Library: Biology and Medicine" series published by the University of Chicago Press and designed to acquaint biologists with certain specialized areas that have been particularly active in the past several years. Clearly, epidemiology can be considered an actively developing specialty of medicine in view of the increasing interest in applying its methods to the noninfectious diseases such as cancer and heart disease.

Dr. Paul has attempted to present an introduction to the principles and philosophy of the epidemiologic approach to the study of disease. His concept of epidemiology is a broad one, in that he feels that it should be applied to the noninfectious diseases and that it is one of the basic sciences of preventive medicine and is not necessarily limited to the practitioners of public health. Thus, it should be an essential part of the armamentarium of the practicing physician.

The tone of this volume is an introductory one, written for medical students, physicians, and other biologists and sociologists who are interested in this area. The emphasis is on general concepts and philosophy rather than on a detailed exposition of the methods used.

VOL. 9 1959

The book is divided into three parts, the first of which consists of definitions and a brief review of the history of this discipline. This is followed by a discussion of principles including a review of the factors that influence the occurrence of disease in man. In addition to the specific causative agent of disease, host susceptibility and environmental factors are reviewed. Various types of epidemiologic approaches such as the experimental and sociologic are briefly discussed. Some of the general methods of measuring disease occurrence such as mortality and illness rates are presented. The need for obtaining some idea of the population exposed to the risk of the disease is emphasized. In all of these discussions, the concepts and methods are well illustrated with examples from various diseases, both infectious and noninfectious.

The last part consists of a discussion of a few diseases to illustrate the application of this approach. The diseases discussed are rheumatic fever, coronary occlusion, poliomyelitis, infectious and serum hepatitis, and the arthropod-borne virus infections.

Dr. Paul is to be complimented on an interesting and well-written exposition of epidemiology, although an introductory one, in which infectious diseases are emphasized. It would have been desirable to include a discussion of the epidemiology of lung cancer, which illustrates most of the presently available epidemiologic techniques that have been used in the study of noninfecticus diseases.

It is unfortunate that if a reader's appetite has been whetted by this volume he will not be able to find a more advanced discussion of this subject in book form. Hopefully, the increasing interest in epidemiology will provide a stimulus for a more definitive exposition of this discipline.

A. Lilienfeld

THE AMPHETAMINES. THEIR ACTIONS AND USES. By Chauncey D. Leake, Ph.D. Springfield, Ill., 1958, Charles C Thomas, Publisher. Pp. 167, indexed. Price $4.50.

Doctor Leake's little book on the amphetamines should be useful as a source of information and references. It is, as the author admits, hardly an exhaustive review. There are also some errors, and a more ruthless critique would have been in order in regard to some of the material. Unfortunate, also, is the considerable amount of repetition which the author has permitted himself. Most pleasant to read are the sections where the author gets up steam because of his obvious interest in an area (e.g., "Sociological Aspects of the Use and Abuse of the Amphetamines"). There his sprightly, vigorous style gets full play.

Louis Lasagna

THE EFFECT OF ADVANCING AGE UPON THE HUMAN SPINAL CORD. By Raymond Morrison, M.D. with the collaboration of Stanley Cobb, M.D., and Walter Bauer, M.D. Cambridge, Mass., 1959, The Commonwealth Fund, Harvard University Press. Pp. 127. Price $6.00.

This book is a histologic atlas of all levels of the normal human spinal cord. The word normal is admittedly used in the relative sense of the word since availability of autopsy specimens from healthy young adults without previous illness is necessarily limited. For this reason, a series of spinal cords at each decade of life from persons with no neurologic symptoms was examined. From this material, the authors have described and illustrated the normal variations occurring in the spinal cord with increasing age.

Unfortunately, the text omits a description of the time from death to autopsy, the technique of removal of the spinal cord, and the method of fixation. These factors are certainly relevant in an interpretation of the significance of subtle cellular and myelin changes such as described here.

Good photomicrographs of Weigert and Nissl preparations from each segment of the spinal cord are reproduced. Meticulous bilateral motor neuron cell counts have been made at each level of the spinal cord, again with the object of establishing the range of normal variation. The pitfalls and sources of error in cell counts and groupings are described. These cell counts and groupings provide quantitative criteria for the appraisal of nerve cell loss in various pathologic conditions.

This is an important reference book for those engaged in the evaluation of the relative specificity of human spinal cord lesions.

Charles N. Luttrell

EXPERIMENTAL PHARMACODYNAMICS. By T. Koppanyi and A. G. Karczmar. Ed. 2, Minneapolis, 1958, Burgess Publishing Co. Pp. 258. Price $5.50.

This book is a laboratory manual for a medical school course in pharmacology. In addition to the experimental procedures the authors have included introductory discussions of basic pharmacology at the beginning of each group of experiments and a discussion of "clinical bearings" at the end of each group. There are twelve divisions including a section on methods of general pharmacology and sections on the pharmacology of the central nervous system, neuroeffector systems, local anesthetics, smooth muscle, histamine, the uterus, the heart, diuretics, cathartics, blood, and chemotherapy. Something over 100 experiments and demonstrations are described. The inclusion of didactic material in addition to procedural directions represents an attempt to "correlate the results and conclusions of this science with the experimental methods . . . ." Unfortunately, this has not been completely successful. The introductory and clinical sections are brief outlines of the subjects which are not always uniquely correlated with the experiments. The majority of the experimental procedures seem sound, although the design of several leaves much to be desired, for example: the application of a large series of nonspecific tests to the urine of drug-treated subjects; an in vitro experiment to demonstrate the effectiveness of mercury antidotes on the basis of visualization of a precipitate; and a diuretic experiment in which the intensity and variety of onslaughts on the kidney make interpretation of the data impossible. Certain opportunities for effective demonstrations have been overlooked. The heart-lung preparation, the Straub preparation, and/or cat papillary muscle experiment would have been valuable additions to the weak section on the heart. The necessary brevity of the didactic material has resulted in a doctrinaire approach. These sections are not free of errors and are not uniformly up to date. The selection of references in some cases is capricious. For example, it is disconcerting to find no reference to papers on ganglion-blocking agents other than nicotine in the section on autonomic ganglia.

This volume will be of value mainly to instructors of pharmacology who may be interested in learning the teaching techniques used in another institution and perhaps expanding their repertoire of student experiments. The didactic sections are not sufficiently authoritative to make the manual a valuable supplement to a good textbook or to serve as a concise review for students.

Irwin M. Weiner

RECENT ADVANCES IN CEREBRAL PALSY. Edited by R. S. Illingworth, M.D. Boston, 1958, Little, Brown & Company. Pp. 389, indexed. Price $12.00.

In this book there is a comprehensive discussion of the many problems with which one is faced in treating the cerebral palsy patient. The disease and its treatment is discussed from all viewpoints by fourteen specialists in the field from the United States, England, and Austria. The many disciplines necessary to competently treat cerebral palsy are ably represented in this book—pediatrics, neurology, education, orthopedics, neurosurgery, physical therapy, speech, and psychology.

Occupational therapy is not discussed as such, but much of what is done by occupational therapists in this country is mentioned under other discussions.

The illustrations are helpful and bibliographies are found at the end of each chapter. The authors are well-known authorities in the field. There is a useful appendix giving detailed information about the many services for the care of the cerebral palsy patient in the United States.

This volume should be a useful addition to the libraries of those dealing with this problem or teaching medical students, physical and occupational therapists, and nurses.

Florence Mahoney

LIPOIDOSES; DISEASES OF THE INTRACELLULAR LIPID METABOLISM. By Siegfried J. Thannhauser, M.D., Ph.D. Ed. 3, New York and London, 1958, Grune & Stratton, Inc. Pp. 600, index. Price $19.75.

This book, by one of the world's authorities on the subject, contains a great deal of information on the chemistry of lipids and on diseases that appear to affect lipid metabolism either directly or indirectly.

Rare metabolic disorders are particularly interesting when they throw light on the processes of normal metabolism and of disease; but the author carefully avoids drawing too many conclusions from the association of hypercholesterolemia with secondary atheroma, which he believes to differ fundamentally from the common forms of arteriosclerosis. His classification of xanthomatoses offers a simple and practical approach to a group of conditions which are still of undertain etiology, and there are excellent accounts of Schüller-Christian disease, eosinophilic granuloma, and Letterer-Siwe disease. Like other recent writers, the author emphasizes the essential unity of these three conditions.

The present edition also includes an absorbing discussion of idiopathic and secondary hyperlipemia, Gaucher's disease, and gargoylism in the light of recent discoveries. Apart from a number of misprints, the book is beautifully produced, with excellent illustrations and an exhaustive list of references.

Maurice Lessof

OL.
9
959

AMINO ACIDS AND PEPTIDES WITH ANTIMETABOLIC ACTIVITY. Ciba Foundation Symposium. Edited by G. E. W. Wolstenholme, O.B.E., M.A., M.B., B.Ch., and Cecilia M. O'Connor, B.Sc. Boston, 1958, Little, Brown & Company. Pp. 286, indexed. Price $8.75.

In March, 1958, the Ciba Foundation sponsored an international symposium which dealt with the chemical and biologic properties of several amino acid and peptide derivatives which possessed antimetabolic or cytotoxic properties. Twenty-nine scientists participated including Bergel, Buchanan, Craig, Farber, Gale, Sheehan, Skipper, and Stock, and this record of papers and discussions is set forth in the familiar style of the Ciba Symposia.

The compounds considered in this symposium have exhibited antibacterial or antitumor action. Such agents as chloramphenicol, etamycin, bacitracin, actinomycin, azaserine, and amino acids carrying nitrogen mustard groups are considered with regard to their chemical synthesis, their relationship to purine and protein biosynthesis, their possible sites and mechanism of action, and the structure-activity relationships which have suggested themselves to date. These areas of knowledge, of course, are relatively unexplored and, because of this, the critique of current achievements and the exchange of ideas and suggestions for future research contained in the discussions seemed of particular interest.

Clinical studies of the antitumor action of the actinomycins and amino acids carrying nitrogen mustard groups are also briefly summarized. The reader is thus provided the opportunity of appreciating the limited clinical achievements thus far made possible by the more basic biochemical investigations. The main value of this volume lies in the multidisciplinary consideration of this group of compounds.

Albert H. Owens, Jr.

CHLOROMYCETIN (Chloramphenicol). By Theodore E. Woodward, M.D., and Charles L. Wisseman, Jr., M.D. Antibiotics Monographs No. 8. New York, 1958, Medical Encyclopedia, Inc. Pp. 159, indexed. Price $4.00.

This book reviews briefly the history, pharmacology, and clinical experience with Chloromycetin since the drug's discovery in 1948. The authors have had an extensive experience with this agent, particularly in typhoid fever, plague, and the rickettsioses. The use of the drug in many other disease entities including staphylococcal infections, urinary tract infections, diseases of the respiratory tract, etc., is also discussed. In every instance the authors' evaluation is objective and the tendency to proselyte is pleasantly lacking. Perhaps there is not enough emphasis

on the big drawback of Chloromycetin—namely, its inability to kill microorganisms in tissues rather than merely inhibit their growth. This is a controversial subject, however, and there is certainly no evidence that a "cidal" antibiotic is needed in the diseases in which Chloromycetin is the drug of choice. On the other hand, the authors do not recommend that this agent be used in situations where a bactericidal drug would be most desirable.

The book emphasizes the practical aspects of antibiotic chemotherapy including dosage, route of administration, blood concentrations attained, etc., and can be recommended as a practical guide to the practicing physician. For those interested in more detailed studies, there is an extensive bibliography containing most of the worthwhile papers on this subject.

Robert G. Petersdorf

HAEMATOLOGY. British Medical Bulletin, Vol. 15, No. 1, January, 1959, pp. 1-88. Price $3.25.

This symposium is mainly concerned with the life cycle of the red blood cells, their growth and development, and their ultimate destruction. The volume makes an important contribution, for the authors who review each of the subjects covered are all actively engaged in investigation of the problems relating to their subjects. The reviews are critical and well referenced, and conclusions are amply supported by original data of the authors. The writing is brief, the illustrations are well presented, and the total effort has produced a volume which should be of value to anyone interested in hematology.

Julius R. Krevans

VOL.
9
195

Announcements

New American Heart Association film, "Back on the Job," shows how heart attack victim is returned to employment.

"Back on the Job," a new film which shows how a heart attack victim is returned to useful employment with the aid of a Heart Association-sponsored Cardiac Work Evaluation Unit, has been produced for the American Heart Association. It is being distributed nationally for showing to lay and professional audiences by the Association's affiliates and chapters.

The film emphasizes the importance of teamwork by the family physician, the employer, and the Work Evaluation Unit in determining when a cardiac patient may resume work without endangering his health. While it is chiefly concerned with a heart attack case, "Back on the Job" also recounts how victims of other heart and circulatory diseases are rehabilitated through the coordinated efforts of the patient's physician and the Work Evaluation Unit's team of cardiologist, social worker, psychiatrist, nurse, and rehabilitation counselor.

"Back on the Job" tells the story of Jack Morgan, 39, mechanic at an oil refinery, who 3 months earlier had suffered a heart attack. Beset by mounting bills, loss of pride, and fear of losing status, he is eager to return to work. At the suggestion of his own physician and the refinery doctor, he visits a Heart Association-sponsored Work Evaluation Unit.

Here he undergoes a series of tests to determine how much physical activity he may undertake with safety to his heart. After the facts have been gathered concerning Jack Morgan's health, his job, and his personal life, the Work Evaluation Unit again confers with his physician. Together they decide that he may return to his former job if his activities are modified. His employer is so notified. Back on the job, Jack's health and spirits quickly improve. Under the close supervision of his physician, Jack gradually resumes all of the duties he performed previous to his heart attack.

More than 50 Cardiac Work Evaluation Units are sponsored by the American Heart Association across the country. The unit depicted in the film is sponsored in Philadelphia by the Southeastern Pennsylvania Heart Association in cooperation with the Pennsylvania Department of Health. The actual team which comprises the unit appears in the film.

Written and directed by George C. Stoney, assisted by Katherine Stoney, Potomac Films, the 16 mm. black and white sound film runs 14½ minutes. It is being distributed throughout the country for showing to the general public over television and at meetings of physicians, state and county medical societies, social workers, nurses, management and union groups, and rehabilitation workers, among others.

The Institute of Physical Medicine and Rehabilitation of New York University-Bellevue Medical Center announces the publication of Rehabilitation Monograph XVI, *The Effects of the California Workmen's Compensation Law Upon the Employment of the Handicapped*, by Morton Lane, LL.B. This 45-page study is one of a number of research studies on cardiovascular rehabilitation being conducted by the Department of Physical Medicine and Rehabilitation under a grant from the National Heart Institute of the United States Public Health Service.

This monograph is the third and final study published by the Institute of Physical Medicine and Rehabilitation on workmen's compensation laws in various states. The first two are *The Effect of the New York Workmen's Compensation Law Upon the Employment of the Handicapped*, 1956, and *The Effect of the Massachusetts Workmen's Compensation Law Upon the Employment of the Handicapped*, 1958.

Copies of the monograph are available for $1.00 each from the Institute of Physical Medicine and Rehabilitation, 400 East 34th Street, New York 16, N.Y.

The First International Medical Conference on Mental Retardation will be held at the Eastland Hotel in Portland, Maine, on July 27 through 31, 1959. The preliminary program is as follows:

Monday, July 27, 1959

Brain Anatomy and Mental Retardation. Paul I. Yakowlew, M.D., Boston, Mass.
The Autonomic Nervous System and Brain Activity. E. Gellhorn, M.D., Minneapolis, Minn.
Enzymology and Brain Activity. D. Y. Y. Hsia, M.D., Chicago, Ill.
The Reticular System. W. F. Ingram, M.D., Iowa City, Iowa.
Discussion and additions.

Tuesday, July 28, 1959

Protein Metabolism and Phenylketonuria. R. S. Paine, M.D., Boston, Mass.
Lipoid and Carbohydrate Metabolism. P. Diezel, M.D., Heidelberg, Germany.
Metabolic Problems of Iron and Copper in Relationship to Brain Diseases. J. N. Cumings, M.D., London, England.
Treatment in Phenylketonuria. M. Bickel, M.D., Marburg, Germany.
Discussion and additions.

Wednesday, July 29, 1959

Experimental Production of Congenital Malformations of the Central Nervous System. J. Warkany, M.D., Cincinati, Ohio.
Birth Injury. P. Schwartz, M.D., Warren, Pa.
Infections and Mental Retardation. H. Asperger, M.D., Innsbruck, Austria.
Asphyxia of the Newborn. L. Stanley James, M.D., New York, N. Y.
Infections Before Birth. M. Schachter, M.D., Marseille, France.
Discussion and additions.

Thursday, July 30, 1959

Our Present Knowledge of the Pathology and Physiology of Mongolism. C. E. Benda, M.D., Waverly, Mass.
Erythroblastosis. W. W. Zuelzer, M.D., Detroit, Mich.
Internal Therapy of Mental Retardation. K. Kundratitz, M.D., Vienna, Austria.
Surgical Treatment in Mental Retardation. (To be announced.)
Kernicterus. H. S. Baar, M.D., Pownal, Maine.
Discussion and additions.

Friday, July 31, 1959

Diagnostic and Therapeutic Aspects of Childhood Schizophrenia. L. Bender, M.D., New York, N. Y.
Mental Retardation as Part of the Training Program in Child Psychiatry. G. E. Gardner, M.D., Boston, Mass.
Differential Diagnosis of Autism, Childhood Schizophrenia, and Heller's Disease. C. E. Benda, M.D., Waverly, Mass.
Behavior Problems and Brain Damage. H. Asperger, M.D., Innsbruck, Austria.
Discussion and additions.

VOL
9
195

The NINTH ANNUAL INSTRUMENT SYMPOSIUM AND RESEARCH EQUIPMENT EXHIBIT will be held Sept. 28 through Oct. 1, 1959, at the National Institutes of Health, Bethesda, Md.

Sponsors of the exhibit are the nation's leading instrument manufacturers, who will display the newest developments in laboratory glassware and electronic, surgical, radiation, optical, gas-sampling, and other research equipment.

Sponsors of the symposium are the Washington, D. C., sections of the American Association of Clinical Chemists, American Chemical Society, Instrument Society of America, Professional Group on Medical Electronics of the Institute of Radio Engineers, Society of American Bacteriologists, and the Society for Experimental Biology and Medicine.

For additional information about the symposium and exhibit, write or call James B. Davis, National Institutes of Health, Public Health Service, Bethesda 14, Md. Phone: OLiver 6-4000, extension 2315.

OL.
9
959

The FOURTH SESSION OF THE TRAINING PROGRAM FOR STEROID BIOCHEMISTRY sponsored by the United States Public Health Service will begin Oct. 1, 1959. Applications are invited at the postdoctoral level for a one-year tenure with a stipend of $5500. The program consists of lectures, planned laboratory, and 8 months of research at the Worcester Foundation for Experimental Biology and Clark University or the University of Utah. Inquiries should be addressed to William R. Nes, Department of Chemistry, Clark University, Worcester, Mass., or to Kristen Eik-Nes, College of Medicine, University of Utah, Salt Lake City, Utah. A predoctoral program also will be carried out in Worcester with stipends of $1800 for 6 months. All applications must be received prior to June 1, 1959.

The TWELFTH ANNUAL SCIENTIFIC MEETING OF THE GERONTOLOGICAL SOCIETY, INC., will be held at the Statler Hotel, Detroit, Mich., Nov. 12 through 14, 1959.

Abstracts of papers should be submitted to the chairman of the appropriate section, for consideration by the Program Committee. Abstracts of exhibits should be sent to the Chairman of the Exhibits Committee for consideration by that committee. Chairmen of the 5 sections and Exhibits Committee are listed below. The deadline for sending in abstracts is July 15, 1959. Abstracts should be submitted in duplicate, double-spaced, and include the title author(s), and the institution or laboratory of origin. The text of the abstracts of papers should include the purpose of the investigation, the general methods, material, and the results or conclusions. The author should indicate at the end of the abstract whether he will present lantern slides and, if so, the size to be used.

Abstracts should not exceed 250 words and should be checked carefully by the authors and be "letter perfect" since galley proofs of abstracts cannot be sent to the authors. Tabular matter should not be included in the abstracts. Order for reprints of abstracts should be sent to the Journal of Gerontology, 660 South Kingshighway Blvd., St. Louis 10, Mo., by Sept. 1, 1959.

Program rules provide that each speaker be given 10 minutes for his paper, followed by a 5-minute period for discussion. Program chairmen will be asked to enforce the 15-minute period, without exception. Speakers are urged to rehearse and time their papers, keeping in mind the importance of opportunity for discussion. Speakers will be limited to one paper for sessions of a particular section.

The theme of the 1959 meeting is "New Frontiers of Research and Training in Gerontology." Members of the individual sections are asked to make their papers conform with the theme and to put special emphasis on new findings and their significance for scientific and social progress in the field of gerontology. The Section on Clinical Medicine, in addition to papers on clinical medicine, invites papers and exhibits in the fields of Dental Medicine, Veterinary Medicine, and Nursing.

Biological Sciences: Dr. Warren Andrew, Department of Anatomy, University of Indiana School of Medicine, Indianapolis 7, Ind.

Clinical Medicine: Dr. Robert T. Monroe, Geriatric Clinic, Peter Bent Brigham Hospital, 270 Commonwealth Ave., Boston, Mass.

Psychological and Social Sciences: Dr. Marion Bunch, Department of Psychology, Washington University, St. Louis 5, Mo.

Social Welfare: Mr. Jerome Kaplan, Mansfield Memorial Homes, Inc., Walpark Bldg., Mansfield, Ohio.

General Membership: Mr. Herbert Shore, The Dallas Home for the Jewish Aged, 2525 Centerville Road, Dallas, Texas.

Local Arrangements Committee: Dr. A. Hazen Price, Chairman, 662 West Kirby Ave., Detroit, Mich.

Exhibits Committee: Dr. Leo Gitman, Chairman, Brooklyn Hebrew Home and Hospital for the Aged, Howard and Dumont Ave., Brooklyn 12, N. Y.

Program Committee: Dr. Wilma Donahue, Chairman, Division of Gerontology, University of Michigan, Ann Arbor, Mich.

VOL.
9
1959

OL.
9
959